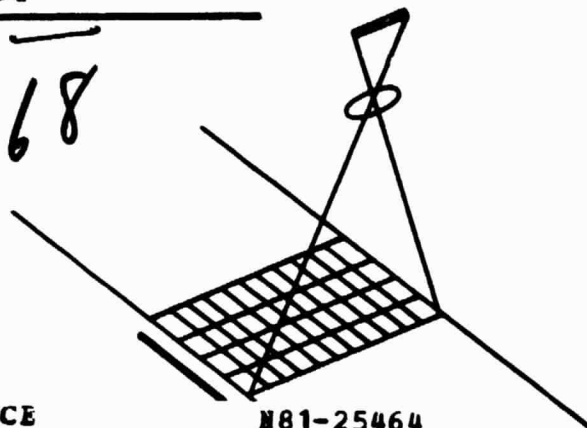


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**MRS
"PROOF-OF-CONCEPT" STUDY
ON BIDIRECTIONAL REFLECTANCE**

**A SIMULATION ANALYSIS OF BIDIRECTIONAL
REFLECTANCE PROPERTIES AND THEIR
EFFECTS ON SCENE RADIANCE —
IMPLICATIONS FOR THE MRS**

By
Dr. James A. Smith
January 1980



**PREPARED FOR
NASA—
GODDARD SPACE FLIGHT CENTER
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**BY
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1400 SPRING ST.
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of three different atmospheres corresponding to clear, medium and heavy haze conditions have been included. An extensive model data base has been generated to provide investigators with means for possible further study of atmospheric correction procedures and sensor design questions.

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FOREWORD

The Multispectral Resource Sampler (MRS) "Proof-of-Concept" Study is intended to be a comprehensive analysis of the corrections that must be applied to MRS data to allow for atmospheric correction factors and the variability of bidirectional reflectance from the scene.

This study was initiated by Dr. Charles Schnetzler of NASA Goddard Space Flight Center, and was performed by ORI, Inc. Space Data and Systems Division with Mr. Charles W. Aitken coordinating the efforts of ORI's consultants.

The complete study results are reported in five separate volumes which have the following titles and authors:

DETERMINATION OF ATMOSPHERIC OPTICAL PARAMETERS USING
THE MULTISPECTRAL RESOURCE SAMPLER, by Dr. Robert E. Turner,
Science Applications, Inc.

ATMOSPHERIC CORRECTION USING AN ORBITAL POINTABLE IMAGING SYSTEM
By Dr. Philip N. Slater, University of Arizona

A SIMULATION ANALYSIS OF BIDIRECTIONAL REFLECTANCE PROPERTIES
AND THEIR EFFECTS ON SCENE RADIANCE--IMPLICATIONS FOR THE
MRS, By Dr. James A. Smith, Colorado State University

MRS LITERATURE SURVEY OF BIDIRECTIONAL REFLECTANCE, By
Dr. James A. Smith, Colorado State University

MRS LITERATURE SURVEY OF ATMOSPHERIC CORRECTIONS
By, Dr. Philip N. Slater, University of Arizona

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A SIMULATION ANALYSIS OF BIDIRECTIONAL REFLECTANCE PROPERTIES
AND THEIR EFFECT ON SCENE RADIANCE -- IMPLICATIONS FOR THE MRS

January 1980

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I. INTRODUCTION

This is the second report in a final report series investigating the effects of bidirectional reflectance trends, for a variety of natural materials, that are relevant to the Multispectral Resource Sampler Concept (Schnetzler and Thompson, 1979). The first report (ORI, Inc., 1979) performed a review, Part I, and synthesis, Part II, of the literature relative to experimental measurements and modeling of scene bidirectional reflectance distribution functions or factors. Based on the synthesis of the work of many different authors from a variety of organizations, specific long-range recommendations were made with respect to both experimental and theoretical work that should be initiated, in conjunction with an on-going Multispectral Resource Sampler (MRS) program. The purpose of this report is to summarize the results of a limited, but intensive, simulation analysis of bidirectional reflectance characteristics including atmospheric effects in order to provide initial guidance for mission planning and sensor design.

Specifically, the objective of this analysis is to:

"Perform a computer modeling and simulation study of the bidirectional reflectance expected from various natural materials such as grassland, forest canopies, and several crop canopies. The effect of several atmospheres should be considered. This should provide the basis for recommendations on sensor or experiment parameters such as the maximum pointing angle desired, optimum sensor bands, optimum target types, and the optimum time of the year for the experiments. The magnitude of the effect of varying atmospheric conditions on bidirectional reflectance should be evaluated."

Additional analyses by other investigators, reported, under separate cover, are concerned with the question of the potential accuracy

of a multiangular viewing MRS for discriminating target types, methods of correcting for bidirectional reflectance and atmospheric variations, and more detailed sensor/experiment parameter questions such as pointing angles, size and type of ground features, bandwidths and so forth. In addition, sensitivity of the radiance received at the spacecraft as a function of variations in aerosol distribution and optical thickness have been studied.

The work reported here is organized into the following sections. First an overview of the analysis approach is given in Section II. This includes a description of the problem, Part A, a description of the calculation of the surface bidirectional reflectance factors, Part B, and a description of the particular numerical approximation method employed for the calculation of the atmospheric effects, Part C. Section III summarizes the specific combinations of surface function and atmospheric state that were simulated. Reference is made to the Appendices which contain the complete data sets calculated. Section IV summarizes the results of some analyses that were made using the simulated data sets including such example trends as effects of pointing angle, and sun angle. Finally, Section V presents the conclusions and recommendations.

II. DESCRIPTION OF THE ANALYSIS APPROACH

A. Definition of the Problem

The general design characteristics and sensor properties of the Multispectral Resource Sampler Concept are outlined in the paper by Schnetzler and Thompson (1979). The MRS is conceived as a sampling, site specific research tool. In order to increase the temporal resolution of the measurements obtained, the sensor is designed to be a pointable device whose field-of-view can be directed to targets off the nadir. An example of the improved temporal resolution that may be so achieved is given in the figure below which has been extracted from the paper by the authors.

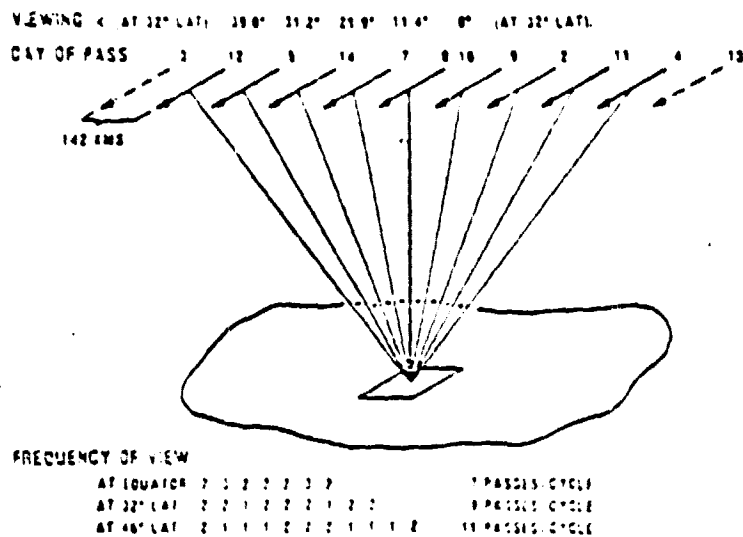


Figure 1. Illustration of the improved temporal resolution provided by the MRS (after Schnetzler and Thompson, 1979). --

At a latitude of 32 degrees north, the MRS could view the same target on day 0 (at a nadir view angle), on day 2 (at 21.9 degrees off-nadir), on day 4 (at 39 degrees off-nadir), on day 5 (at 31.2 degrees off-nadir) and so forth. The relative frequency of each of these views, i.e., the number of overpasses per cycle, is latitude-dependent. Also, of course, the relative sun angle and, thus, the sun angle/view angle relationships vary with latitude.

The key question associated with the MRS sensor, consequently, is what are the impacts both negative and, possibly, positive of the radiometric variations imposed by the varied sun/sensor viewing geometries which would be obtained with the MRS? An analysis of surface bidirectional reflectance factors and atmospheric-induced variations, and, more importantly, their combined effects is required to address this question.

A complete solution to the general problem of arbitrary surface geometries and atmospheric configuration is not available. However, simpler problems may be posed which are both useful and mathematically tractable. For this analysis, we assume the atmosphere to be plane-parallel, spatially homogeneous (horizontally), and non-absorbing. However, both Rayleigh and Mie scattering are included. For the primarily visible wavelengths employed in the MRS these assumptions are not too restrictive. A version of the Turner (1974) atmospheric radiative transfer model is employed to perform the necessary calculations.

A variety of surface vegetative covers were also simulated in the following analysis. Canopy geometry and leaf area were varied. Level

topography and azimuthal symmetry with respect to view and sun angle were assumed. Further, the implicit assumption is made that the targets consist of large fields or other large areas; that is, edge effects and horizontal variations are not included. However, even with these assumptions rather complex surface bidirectional reflectance factor matrices may be computed for the cartesian cross product of zenith sun angle versus zenith view angle.

Mathematically, given the foregoing assumptions, the MRS problem may be formulated by the following set of equations in which the wavelength dependence has been suppressed.

The one-dimensional equation of radiative transfer describing the atmosphere - scene system is given by:

$$\frac{dL}{d\tau} = L(\tau, \mu, \phi) - \frac{1}{4\pi} E_s(\tau) P(\tau; \mu, \phi; -\mu_0, \phi_0) - \frac{1}{4\pi} \int_0^{2\pi} \int_{-1}^1 P(\tau; \mu, \phi; \mu', \phi') L(\tau; \mu', \phi') d\mu' d\phi' \quad (1)$$

Subject to the boundary conditions:

$$L(0; -\mu, \phi) = 0 \quad (2)$$

$$L(\tau_0; \mu, \phi) = \int_0^{2\pi} \int_0^1 \mu' f_r(\mu, \phi - \mu', \phi') L(\tau_0; -\mu', \phi') d\mu' d\phi' \quad (3)$$

where:

τ is the optical depth

τ_0 is the total atmospheric optical depth

μ is the cosine of the zenith angle

ϕ is the azimuth angle

L is the radiance

topography and azimuthal symmetry with respect to view and sun angle were assumed. Further, the implicit assumption is made that the targets consist of large fields or other large areas; that is, edge effects and horizontal variations are not included. However, even with these assumptions rather complex surface bidirectional reflectance factor matrices may be computed for the cartesian cross product of zenith sun angle versus zenith view angle.

Mathematically, given the foregoing assumptions, the MRS problem may be formulated by the following set of equations in which the wavelength dependence has been suppressed.

The one-dimensional equation of radiative transfer describing the atmosphere - scene system is given by:

$$\frac{dL}{d\tau} = L(\tau, u, \phi) - \frac{1}{4\pi} E_s(\tau) P(\tau; u, \phi; -\mu_0, \phi_0) \quad (1)$$

$$+ \frac{1}{4\pi} \int_0^{2\pi} \int_{-1}^1 P(\tau; u', \phi'; u, \phi) L(\tau; u', \phi') du' d\phi'$$

Subject to the boundary conditions:

$$L(0; -u, \phi) = 0 \quad (2)$$

$$L(\tau_0; u, \phi) = \int_0^{2\pi} \int_0^1 u' f_r(u, \phi - u', \phi') L(\tau_0; -u', \phi') du' d\phi' \quad (3)$$

where:

τ is the optical depth

τ_0 is the total atmospheric optical depth

u is the cosine of the zenith angle

ϕ is the azimuth angle

L is the radiance

E_s is the direct solar radiance at optical depth

P is the phase function of the medium

fr is the surface bidirectional reflectance distribution function (Nicodemus, 1970).

The Lambertian assumption is often made for the surface boundary condition i.e., $L(\tau_0; \mu, \theta) = \frac{1}{\pi} \rho E_T(\tau_0)$ where ρ is the average surface reflectance factor, assumed independent of source and view directions and E_T is the total downward radiance at the surface.

In our analysis, we make a slightly different assumption. First, we rewrite equation (3) as:

$$L(\tau_0; \mu, \theta) = \frac{1}{\pi} E_s(\tau_0) fr(\mu, \theta; -\mu_0, \theta_0) + \frac{1}{\pi} \int_0^{2\pi} \int_0^1 fr(\mu, \theta; -\mu', \theta') L(\tau_0; -\mu', \theta') \mu' du' d\theta'$$

separating the direct and diffuse reflected surface components. For most sun and view angle combinations the second term is much smaller than the direct term. We approximate it by:

$$\int_0^{2\pi} \int_0^1 fr(\mu, \theta; -\mu', \theta') L(\tau_0; -\mu', \theta') \mu' du' d\theta' = \frac{1}{\pi} fr(\mu, \theta; -\mu_0, \theta_0) E_0(\tau_0)$$

where E_0 is the total diffuse irradiance field at the surface. That is, for a given view angle and sun angle, we employ the corresponding reflectance factor for both the direct and diffuse terms.

Thus, rather than boundary condition (3) we utilize the following approximation:

$$L(\tau_0; \mu, \theta) = \frac{1}{\pi} E_T(\tau_0) \rho(\mu, \theta; -\mu_0, \theta_0) \quad (3')$$

Note, that we have also explicitly indicated the use of the bidirectional reflectance factor, ρ , after Kriebel (1977). That is, for small solid angles we actually employ:

$$\rho(\omega_r; \omega_r) = \frac{\int_{\omega_r} \int_{\omega_i} f_r(\omega_r; \omega_i) \mu \mu' du d\phi du' d\phi'}{\int_{\omega_r} \int_{\omega_i} \mu \mu' du' d\phi' du d\phi}$$

In summary, we have formulated the simulation analyses to be performed for the study of bidirectional reflectance properties and their effect on scene radiance in terms of equation (1) and the two boundary conditions (2) and (3'). The three equations explicitly depend upon the surface bidirectional reflectance factor matrix, ρ , the atmospheric optical depth and phase function, viewing geometry, and solar geometry. The reflectance factor matrix, in turn, depends upon surface type and characterization. These parameter dependencies thus permit us to calculate scene radiance incident upon the MRS sensor as a function of both atmospheric and target state for a variety of angular geometries and wavelengths.

The remainder of this section is concerned first with the calculation of the bidirectional reflectance factor matrices, Section B; then with the solution technique employed for equation (1) plus boundary conditions, Section C.

B. Simulation of the Bidirectional Reflectance Factors

A Monte Carlo technique, the Solar Radiation Vegetation Canopy model (SRVC) described by Oliver and Smith (1974) was used to calculate the intrinsic surface bidirectional reflectance factors. This model was

first developed for grassland canopies, then extended to wheat canopies by Smith, Berry and Heimes (1975), and further extended to lodgepole pine canopies (Kimes, Ranson, Kirchner, and Smith, 1978). With the proper input parameters for each vegetation type the model predicts reflectance factors for sectors of 10 degrees zenith angle by 30 degrees azimuth. Since azimuthal isotropy of reflectance is assumed in this study, a nine by nine reflectance factor matrix is calculated.

Data required to run the SRVC model can be broken down into roughly three groups. One group contains the information necessary to describe the irradiance distribution. Another group characterizes the canopy geometrically, while the third group consists of the optical reflectance and transmission parameters for each material type in each layer of the canopy. The date, time, solar declination, altitude and longitude are required in the first group to define the position of the sun in the hemisphere. Total global and diffuse irradiance must also be specified. The second group contains the leaf area index, canopy density, number of layers in the canopy to be modeled, the number of material types in each layer, and angle distributions for each of these types in each layer. These geometry data may be measured in the field (Kimes, Smith and Berry, 1979; Smith and Berry, 1979) or taken from curves of ideal geometrical arrangements as given by deWit (1965). Lastly, background reflectance and canopy element reflectances and transmittances must be included for all wavelengths simulated.

One advantage of using mathematical models such as SRVC for determination of bidirectional reflectance factors is that the irradiance impinging upon the target can be specified. This is quite important because the model may first be calibrated so that its predictions

closely approximate field observations under natural conditions. Once this is accomplished, specific irradiances may be imposed to derive the true bidirectional reflectance factors.

The first step in determining reflectance factors is to assure agreement of model predictions with field observations. This has been done for two of the vegetation types selected for this study. Figure 2 shows the simulated and measured reflectances at six wavelengths for a lodgepole pine canopy. Similarly, comparisons of model predictions and field observations for a grass canopy are given in Figure 3.

Once the model satisfactorily simulates canopy normalized reflectance, the irradiance conditions can be varied using only direct radiation from the sun. All diffuse sources are set to zero. Solar zenith angles at 10° intervals from 5° to 85° were selected for this study. The azimuth of the source was set equal to zero. Since the proportion of energy reflected into each of nine sectors is given for each incidence angle, the resulting set of spectral reflectance factors can be written in the form of a nine by nine matrix. These matrices were derived for both lodgepole pine and grass at wavelengths of .68 μ m, where chlorophyll absorption takes place, and .80 μ m in the near infrared region of the electromagnetic spectrum. Three dimensional views of the surface of each distribution are seen in Figures C.1.1 and C.1.2 of Appendix C.

In order to assess the impact of leaf area index variations and canopy structure on bidirectional reflectance, reflectance factor matrices were also derived for five theoretical grass canopies. All model input parameters remained the same for the actual grass canopy except for the LAI and the geometry. The measured LAI was 1.2, so 0.6

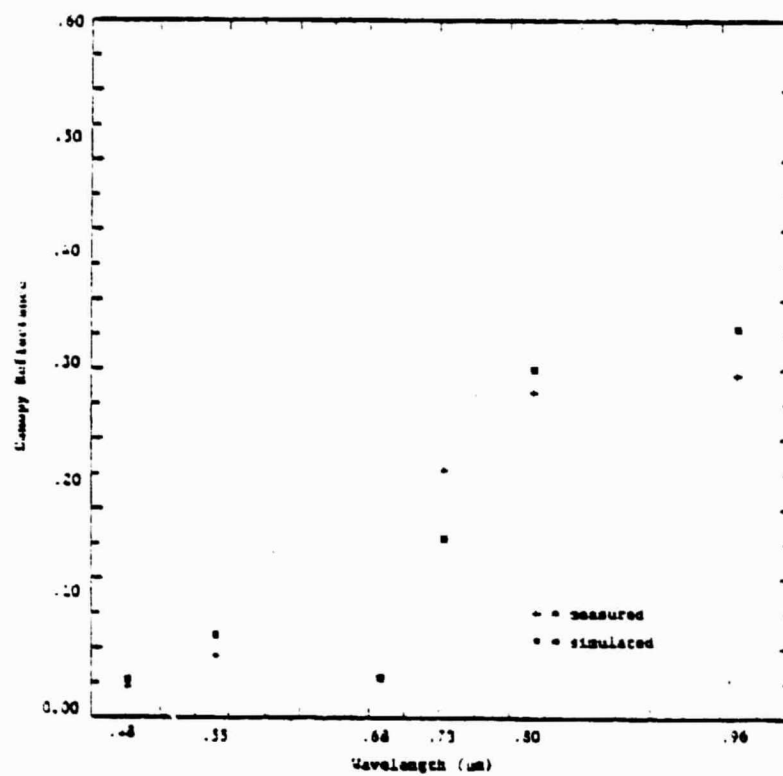


Figure 2. Simulated and measured reflectances at six wavelengths for a lodgepole pine canopy.

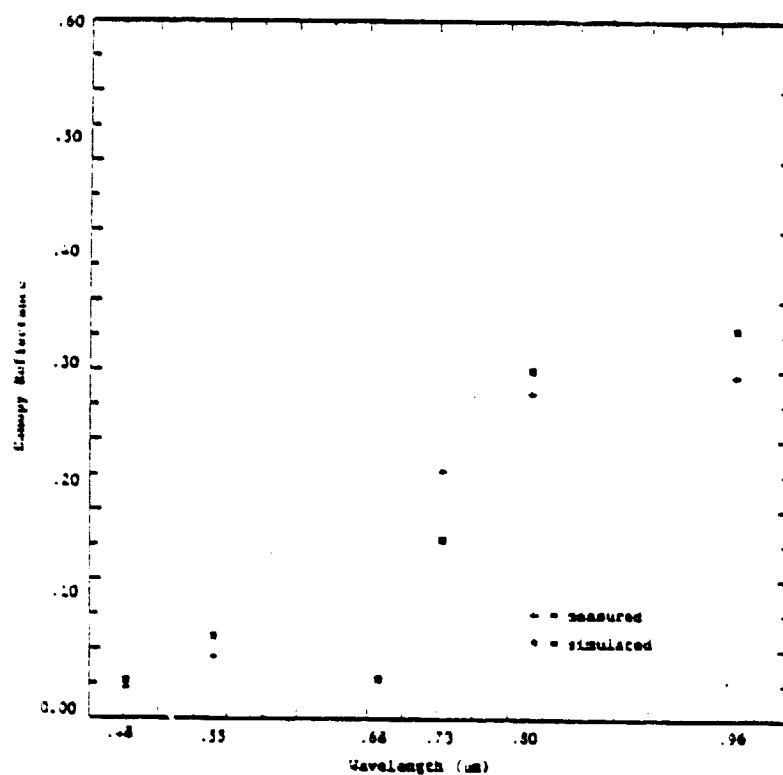


Figure 2. Simulated and measured reflectances at six wavelengths for a lodgepole pine canopy.

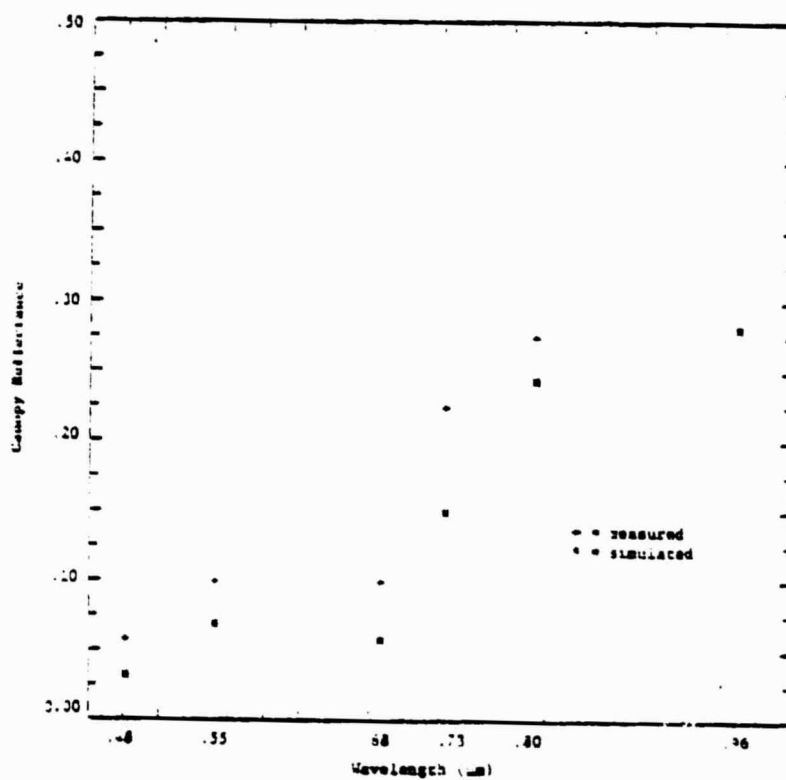


Figure 3. Simulated and measured reflectances at six wavelengths for a grass canopy (*Agropyron* sp.)

and 4.0 were substituted to represent low and high indices respectively. The grass had a geometrical structure which very closely approximated the spherical canopy of deWit (1965). As an alternate, a planophile geometry was selected which has the greatest proportion of its leaves oriented horizontally at all angles of the spherical canopy. The same three leaf area indices were used as for the spherical geometry to allow comparison.

Finally, additional reflectance factor data were obtained from the literature. Reflectance factor matrices including azimuthal dependencies were obtained from Kriebel (1977) for a coniferous forest and pastureland at a wavelength of 0.606 and 0.866 micrometers. Measured agricultural reflectance data were obtained from deBoer et al., (1974). Data for mature wheat at a sun angle of 53 degrees zenith and for view angles of 0, 15, 25, 35, and 45 degrees and for young wheat for three combinations of sun/sensor geometries, including azimuth, were obtained.

C. Simulation of Atmospheric Effects

There are many possible solution approaches for the atmospheric radiative transfer equation (1) plus boundary conditions, (2), and (3'). Kondratyev (1969), Paltridge and Platt (1976), and especially Wolfe and Zissis (1978) summarize many of these methods. The specific method described by Turner (1974) was employed in this study for the simple and expedient reason that this model was readily available to the authors. Basically, the Turner model calculates the spectral path radiance and the total spectral radiance according to a modified two-stream calculation initially, employing a double delta approximation for the medium phase function. The model assumes that there are both

Rayleigh and Mie scatterers within the homogeneous (horizontal) layer, but no absorption; that is, the single scattering albedo is taken to be one. Both isotropic and anisotropic scattering are included.

As discussed in the Literature Review, Part II (ORI, Inc., 1979) the immediate difficulty in solving the radiative transfer equation (1) is that the solution for the radiance for any given direction, μ, ϕ , depends upon a knowledge of the "source" radiance for all directions. Thus, iterative techniques are commonly employed-

Rewriting equation (1) we have:

$$\mu \frac{dL}{d\tau} = L(\tau; \mu, \phi) - \frac{1}{4\pi} E_s(\tau) P(\mu, \phi; -\mu_0, \phi_0) - \frac{1}{4\pi} \int_0^{2\pi} \int_{-1}^1 P(\mu, \phi; \mu', \phi') L(\tau; \mu', \phi') d\mu' d\phi' \quad (1)$$

An initial approximation to $L(\mu', \phi')$ is developed as explained below. In the above expression, the phase function for the medium is assumed to be a weighted average of the Rayleigh phase function, P_{RAY} , and a haze phase function. The haze phase function, P_{DER} , for a particular wavelength is taken from Deirmendjian (1969).

$$P_{MEDIUM} = \frac{(\tau_0 - \tau_{RAY}) P_{DER} + \tau_{RAY} P_{RAY}}{\tau_0}$$

where the optical depth values are taken from tabulations by Elterman (1970).

Given the initial source radiance, as derived below, and the above phase function, equation (1) may then be evaluated.

To develop an initial approximation for the source radiance, the phase function is first expressed as a double delta (dirac) function:

$$P(\mu, \phi; \mu', \phi') = 4\pi\eta(\mu' - \mu) \delta(\phi' - \phi) + 4\pi(1-\eta) \delta(\mu' + \mu) \delta(\phi' - \pi - \phi) \quad (4)$$

where η is an anisotropy parameter representing the fraction of radiation scattered into the forward hemisphere. For Rayleigh scattering, $\eta = 0.5$. In the visible region, $\eta = 0.95$ for aerosol scattering.

Turner makes the following weighted average computation for the medium as a whole:

$$\eta = \frac{0.5 \tau_{\text{RAY}} + 0.95 (\tau_0 - \tau_{\text{RAY}})}{\tau_0}$$

A modified two-stream approximation is made for the initial source radiance by expressing it as the sum of an upward, E_+^i , downward, E_-^i , anisotropic field and an upward, E_+^u , downward, E_-^u , isotropic field:

$$L(\tau; \mu', \phi') = \frac{1}{u_0} [E_+^i(\tau) \delta(\mu' - u_0) \delta(\phi' - \pi - \phi_0) + E_-^i(\tau) \delta(\mu' + u_0) \delta(\phi' - \phi_0)] + [E_+^u(\tau) + E_-^u(\tau)]/2\pi \quad (5)$$

Substituting equations (4) and (5) into equation (1) leads to a system of two equations for E_+^i , E_-^i and two equations for E_+^u , E_-^u as explicitly given by Turner (1974).

For this study a computer program incorporating the above approach had previously been obtained by the authors from the NASA Johnson Spacecraft Center and implemented on the Colorado State University CYBER 172 computer system. In practice, the following input parameters must be specified:

Horizontal visual range (which is later converted by the program
and altitude into optical depth)

Viewing angles

Sun angles

Wavelength

Target reflectance factors (as computed by the SRVC analysis
described in Section B).

The program was appropriately modified to incorporate the nine by
nine reflectance factor matrix for the surface boundary condition and
as required for the literature values of Kriebel and deBoer, et al.

III. DESCRIPTION OF THE SIMULATION PERFORMED

The basic approach involved in this study was to select representative plant canopies that would encompass the variability that might be expected under the viewing and illumination conditions of the MRS. We incorporated two sources of scene variability; the first being type, and the second condition. A total of six different types of vegetation canopies were included in the analyses. There were two different types of a generalized grass canopy, a lodgepole pine canopy, pasture, a second coniferous forest canopy, and wheat. In addition to the six different types of vegetation canopies, an examination of reflectance dependence on leaf area index or biomass was undertaken. Finally, a wheat crop at two different stages of development was examined. Thus, a total of 10 different vegetation surfaces were investigated. The SRVC model was run to generate the bidirectional reflectance distribution factors for seven of the surfaces and measurements obtained from the literature were used for three of the vegetation types. For all surfaces, the analyses were performed at the chlorophyll absorption band in the red region and at the infrared plateau. Two different canopy architectures were utilized for the grass canopy. The first was a spherical distribution, indicative of many natural grasses and wheat; the second was planophile architecture, indicative of such crops as sorghum.

The 10 vegetation surfaces were then utilized in the atmospheric model to calculate spectral radiance and spectral path radiance. A significant effect of seasonal data acquisition is the wide variability

in sun angle at the time of acquisition. In order to cover the wide range possible in sun/sensor relationships, the authors simulated the atmospheric-scene system for the total range of solar and view zenith angles between 5 degrees and 85 degrees. Five different relative azimuth angles were also investigated in the study. Finally, three different atmospheric states were simulated by using horizontal visibilities of 4 km, 10 km, and 23 km. These three visibilities correspond roughly to hazy, light haze, and clear atmospheres.

Table 1, summarizes both the surface and atmospheric combinations that were run. A complete analysis of nine surfaces times nine view angles times nine solar zenith angles times five azimuth angles times three atmospheres times two wavelengths was made. In addition, analysis of measured wheat data for selected sun-sensor combinations were also performed. In total, approximately 2300 simulation runs were made.

Appendix A, Bidirectional Reflectance Distribution Functions for Various Types, includes the complete set of nine by nine bidirectional reflectance distribution factor matrices that were used in the analyses. Appendix B, Simulation Analysis Results, contains the complete set of spectral radiance and path radiance matrices for all combinations of view, solar, azimuth, and visibility combinations. All subsequent analyses were extracted from these data.

Table 1.

SIMULATION ANALYSIS

<u>SRVC</u> (MODEL)	<u>KRIEBEL</u> (MEASUREMENTS)
<u>SURFACES</u>	
SPHERICAL GRASS CANOPY LAI = .5, 1.2 AND 4.0	PASTURE
PLANOPHILE GRASS CANOPY LAI = .5, 1.2 AND 4.0	
LODGEPOLE PINE CANOPY	CONIFEROUS FOREST
WAVELENGTHS	
.68 μM	.606 μM
.80 μM	.866 μM

ZENITH VIEW ANGLES

5°, 15°, . . . 85°

SOLAR ZENITH ANGLES

5°, 15°, . . . 85°

AZIMUTH ANGLES

0°, 60°, 90°, 120°, 180°

VISIBILITIES

4km, 10km, 23km

IV. ANALYSIS RESULTS

Approximately 2300 simulation runs were made to generate a data base representative of the potential atmosphere/target variations that might be expected from the MRS sensor. For each simulation run both total radiance and path radiance were calculated. Additionally, we define the target or scene radiance to be the difference between total radiance and path radiance.

Given available time and resources, the authors elected to perform analyses on subsets of this data base in order to answer some of the more pressing design questions relative to the MRS concept. We performed the analysis in two stages. First, a reconnaissance analysis in order to address some general questions and finally an exhaustive analysis relative to determining view and sun angle variations according to target type.

The first analysis performed was to examine the order of magnitude variation in total spectral radiance for two very different surface cover types as a function of both view angle and relative azimuth angle. These results are shown in Figure 4, for the pasture and conifer data of Kriebel calculated for the chlorophyll absorption band; Figure 5 shows the same analyses for the spherical grass and lodgepole pine canopies simulated by the authors for both the chlorophyll and near infrared wavelengths. It is evident from both the figures that the dependence on relative azimuth is much less than on the variability due to zenith view angle changes. In both cases the solar zenith angle was 5 degrees. Relative azimuths of 0 and 180 degrees differ on the order of 5 percent from the nominal values at the relative azimuth of 90 degrees.

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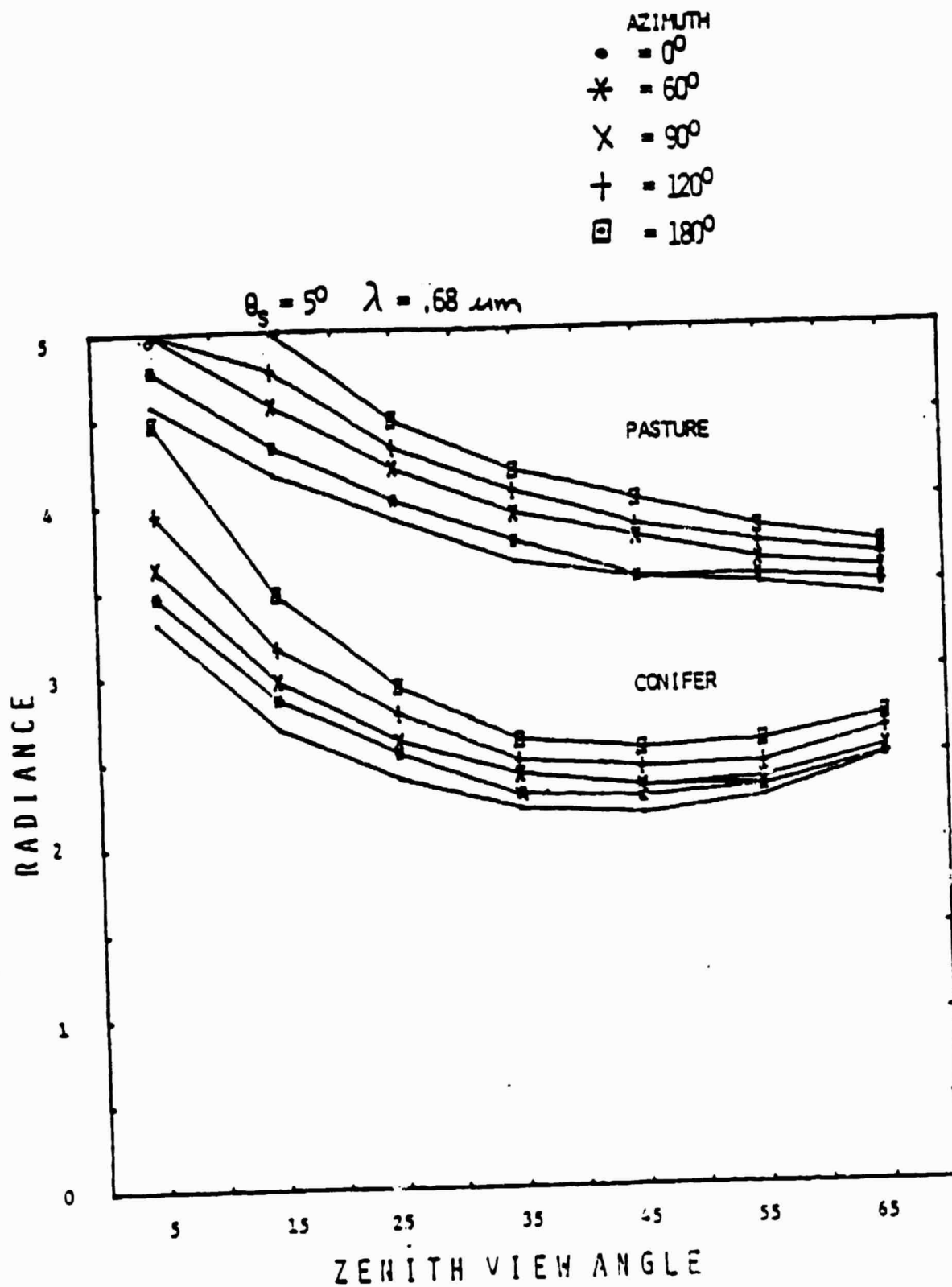


Figure 4. Kriebel data.

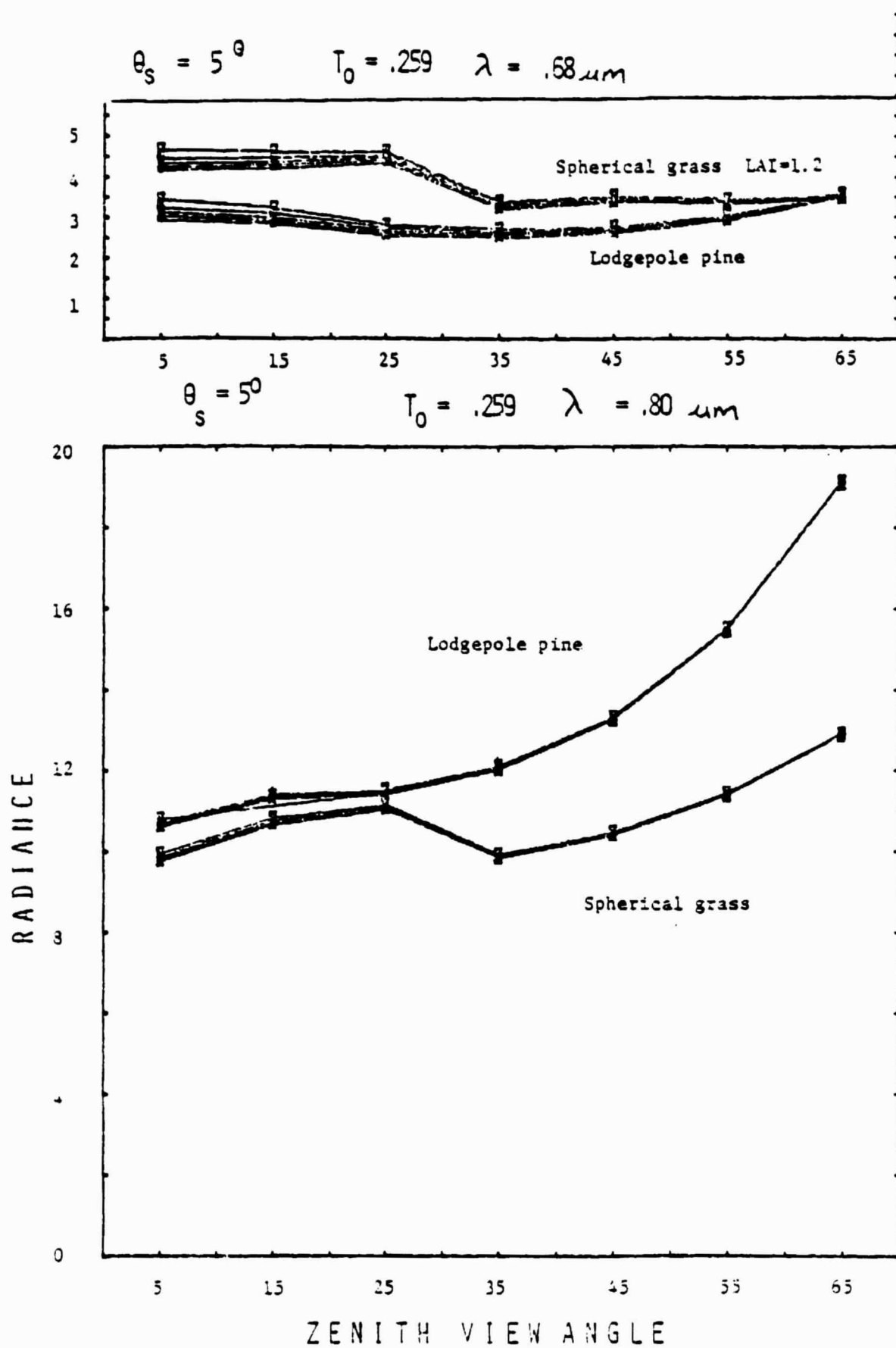


Figure 5. Simulated data.

These results were examined in further detail as shown in Tables 2 and 3. In these tables the percent changes in total spectral radiance at each zenith view angle for each relative azimuth angle was calculated relative to the nominal value of 0 degrees zenith view angle. Subsequently, all changes greater than 10 percent were flagged and are indicated by an x in the tables. Generally, it is seen that the variability with view angle is less for the near infrared than for the visible wavelengths. The forest canopy also appears to be more sensitive to view angle changes. For the high sun angle case, the variation in spectral radiance with view angle is of the order of 10 percent for ranges up to 25 to 30 degrees zenith view angle.

The dependence of both total radiance and target radiance, defined as the difference between total radiance and path radiance, on zenith view angle and sun angle for selected cases are shown in Appendix C. These plots show the variation of radiance versus the appropriate variable for each of five natural surfaces. Figure C.2.1 is the total radiance versus zenith view angle between 5 and 65 degrees for a solar zenith angle of 5 degrees. Figure C.2.2 illustrates the same plots but now for a solar zenith angle of 55 degrees. Figure C.2.3 shows the total radiance plotted versus the solar zenith angle for angles between 5 and 65 degrees. Figure C.2.3 is for a zenith view angle of 5 degrees and Figure C.2.4 is for a zenith view angle of 55 degrees.

The target radiances were then calculated for each case and are shown in Figures C.3.1 through C.3.4.

Next, a fairly exhaustive analysis was performed for the clear atmosphere case for the seven simulated surfaces relative to variations

LODGEPOLE PINE $\theta_s = 5^\circ$, $\lambda = .63\mu\text{m}$. $T_o = .239$

ZENITH VIEW ANGLE (degrees)

		5	15	25	35	45	55	65
A	0		X	X	X	X	X	X
Z	60			X	X	X	X	X
I								
M	90			X	X	X		X
U								
T	120			X	X	X		X
H								
	180	X		X	X	X		X

LODGEPOLE PINE $\theta_s = 5^\circ$ $T_o = .222$ $\lambda = .80\mu\text{m}$.

ZENITH VIEW ANGLE (degrees)

		5	15	25	35	45	55	65
A	0				X	X	X	X
Z	60				X	X	X	X
I								
M	90				X	X	X	X
U								
T	120				X	X	X	X
H								
	180				X	X	X	X

Table 2. Lodgepole pine canopy.

Table 3. SPHERICAL GRASS LAI = 1.2, $\theta_s = 5^\circ$, $\lambda = .68\mu m$. $T_o = .259$

		ZENITH VIEW ANGLE (degrees)						
		5	15	25	35	45	55	65
A Z I M U T H	0				X	X	X	X
	60				X	X	X	X
	90				X	X	X	X
	120				X	X	X	X
	180				X	X	X	X

SPHERICAL GRASS CANOPY LAI = 1.2 $\theta_s = 5^\circ$ $T_o = .222$ $\lambda = .80\mu m$.

		ZENITH VIEW ANGLE (degrees)						
		5	15	25	35	45	55	65
A Z I M U T H	0			X			X	X
	60			X			X	X
	90			X			X	X
	120			X			X	X
	180		X	X			X	X

in zenith view and sun angles. All possible combinations of these angles between 5 and 65 degrees were examined. The objective was to refine the nominal values presented by Kriebel (1978) who quoted average variabilities in reflected radiation by vegetated surfaces for differences in solar zenith angle. Kriebel presented one single average value for the complete range of solar zenith angle as shown in the enclosed table (Table 4). We refined Kriebel's results by expanding the analysis to include multiple wavelengths and to calculate the percent change in reflected radiance due to a change per degree of solar zenith angle as a function of the viewing angle. In addition, we calculated the percent change in scene radiance per degree change in sensor zenith angle for given solar zenith angles. These results are shown in Tables 5, and 6.

In each case we calculated the following averages:

For a given sensor view angle, θ_v :

$$\langle \theta_{\text{sun angle}} \rangle = \frac{\int_{\theta_{\text{sun}}=5}^{65} [LT(\theta_{\text{sun}}) - LP(\theta_{\text{sun}}/\theta_v)] d\theta_{\text{sun}}}{\int d\theta_{\text{sun}}}$$

and for a given solar zenith angle, θ_s :

$$\langle \theta_{\text{sensor angle}} \rangle = \frac{\int_{\theta_v=5}^{65} [LT(\theta_v/\theta_{\text{sun}}) - LP(\theta_v/\theta_{\text{sun}})] d\theta_v}{\int_{\theta_v=5}^{65} d\theta_v}$$

Kriebel, K.T. 1973. Average Variability of the Radiation Reflected by Vegetated Surfaces due to Differing Irradiations. Remote Sens. Environ. 7:81-83.

Table 4

Percent Change of the Reflected Radiance due to a Change of the Distribution of the Irradiation either by one Degree of the Solar Zenith Angle or by 10% Change of the Optical Depth of the Atmosphere. Averaged over all Directions of Reflection and over all Distributions of the Irradiation.

Surface type	Average change of the reflected radiance	
	Per degree change of the solar zenith angle	Per 10% change of the optical depth
Savannah	$\pm 1.0\%$	$\pm 1.6\%$
Bog	$\pm 0.9\%$	$\pm 0.7\%$
Pasture land	$\pm 1.7\%$	$\pm 1.0\%$
Coniferous forest	$\pm 2.3\%$	$\pm 1.5\%$
Average over the four surfaces	$\pm 1.5\%$	$\pm 1.2\%$

Table 4. Kriebel results.

		Zenith View Angle						
		$\tau_0 = .259$						
		$\lambda = .68\mu\text{m}$						
	Surface	5°	15°	25°	35°	45°	55°	65°
S 0.5	Grass 1	.7	.8	.8	.9	.5	.6	.9
S 1.2	Grass 2	.6	1.4	1.6	.8	.6	.8	.6
S 4.0	Grass 3	.5	.7	.9	.7	.7	.6	.6
P 0.5	Grass 4	.7	.6	.7	.7	.7	.7	.6
P 1.2	Grass 5	.7	.7	.7	.7	.7	.7	.7
P 4.0	Grass 6	.7	.7	.7	.7	.7	.7	.7
	Lodgepole	1.0	1.3	.9	.9	.9	.8	.9

		Zenith View Angle						
		$\tau_0 = .222$						
		$\lambda = .80\mu\text{m}$						
	Surface	5°	15°	25°	35°	45°	55°	65°
S 0.5	Grass 1	.6	.6	.7	.7	.4	.4	.7
S 1.2	Grass 2	.5	.9	1.0	.6	.4	.5	.4
S 4.0	Grass 3	.7	.7	.7	.7	.5	.4	.7
P 0.5	Grass 4	.7	.6	.7	.7	.7	.7	.6
P 1.2	Grass 5	.7	.7	.7	.7	.7	.7	.7
P 4.0	Grass 6	.7	.6	.6	.6	.6	.6	.6
	Lodgepole	.9	1.1	1.0	.9	.9	.8	.8

Table 5. Percent change in scene radiance from several natural surfaces per degree change in sun angle for given sensor zenith view angles. Atmospheric visibility was 23 km, satellite altitude was 900 km. Grasses 1-3 have spherical foliage geometry with LAI=.5, 1.2 and 4.0 respectively. Grasses 4-6 have planophile foliage geometry with LAI=.5, 1.2 and 4.0 respectively.

		Solar Zenith Angle						
		$\tau_0 = .259$						
		$\lambda = .68\mu\text{m}$						
	Surface	5°	15°	25°	35°	45°	55°	65°
S 0.5	Grass 1	.5	.5	.4	.3	.5	.3	.4
S 1.2	Grass 2	.7	.7	1.2	1.0	.6	.4	.2
S 4.0	Grass 3	.3	.2	.3	.3	.4	.4	.4
P 0.5	Grass 4	.4	.4	.4	.4	.3	.3	.4
P 1.2	Grass 5	.3	.3	.3	.3	.3	.3	.3
P 4.0	Grass 6	.4	.4	.4	.4	.4	.2	.2
	Lodgepole	.6	.5	.3	.6	.6	.7	.9

		Solar Zenith Angle						
		$\tau_0 = .222$						
		$\lambda = .80\mu\text{m}$						
	Surface	5°	15°	25°	35°	45°	55°	65°
S 0.5	Grass 1	.2	.2	.2	.2	.2	.2	.2
S 1.2	Grass 2	.4	.2	.4	.3	.2	.2	.2
S 4.0	Grass 3	.4	.4	.4	.4	.4	.4	.5
P 0.5	Grass 4	.3	.3	.3	.3	.2	.2	.3
P 1.2	Grass 5	.2	.2	.2	.2	.2	.2	.2
P 4.0	Grass 6	.3	.3	.3	.2	.2	.2	.2
	Lodgepole	.7	.6	.5	.7	.9	.8	.9

Table 6 . Percent change in scene radiance from several natural surfaces per degree change in sensor zenith view angle for given solar zenith angles. Simulated atmospheric visibility was 23 km, satellite altitude was 900.0 km. Grasses 1-3 have spherical foliage geometry with LAI=.5, 1.2 and 4.0 respectively. Grasses 4-6 have planophile foliage geometry with LAI=.5, 1.2, and 4.0, respectively.

where LT = total spectral radiance

LP = path spectral radiance

It should be noted from the tables that for all surfaces, we find less sensitivity of scene radiance per degree change of solar zenith angle than reported by Kriebel although they are both of the same order of magnitude. Also in agreement with Kriebel, the dependence of the coniferous forest canopy is greater. We also find less sensitivity of scene radiance to degree changes in the viewing angle. Generally, the tables exhibit relatively smooth variations across solar or viewing angle.

In an attempt to examine the off-angle viewing effects on transformed variables, the authors calculated the TVI or transformed vegetation index defined as:

$$TVI = \frac{IR + RED}{IR - RED}$$

Table 7 shows the TVI calculated as a function of viewing angle for both a high, solar angle of 5 degrees, and a larger solar zenith angle of 45 degrees. TVI has been calculated for the spherical and planophile grass canopies with LAI's ranging from 0.5 to 4.0 in each case. In the tables, it is seen that the TVI is a fairly good normalization of the viewing angle index up to about 45 degrees zenith view angle. Further, the TVI yields approximately the same value for a given leaf area index independent of canopy structure. There is a weak dependence on solar zenith angle.

		TVI at View Angle						$\theta_s = 5^\circ$
	Surface	5°	15°	25°	35°	45°	55°	65°
S 0.5	Grass 1	2.5	2.6	2.4	2.5	2.1	1.9	1.8
S 1.2	Grass 2	1.8	1.8	1.9	1.6	1.6	1.5	1.5
S 4.0	Grass 3	1.5	1.5	1.5	1.5	1.4	1.4	1.4
P 0.5	Grass 4	2.4	2.4	2.5	2.5	2.3	2.3	2.2
P 1.2	Grass 5	1.6	1.6	1.6	1.6	1.5	1.5	1.5
P 4.0	Grass 6	1.5	1.4	1.4	1.4	1.4	1.4	1.4

		View Angle $\theta_s = 35^\circ$						
	Surface	5°	15°	25°	35°	45°	55°	65°
S 0.5	Grass 1	2.3	2.4	2.3	2.3	2.2	2.0	1.7
S 1.2	Grass 2	1.8	1.6	1.6	1.5	1.6	1.4	1.4
S 4.0	Grass 3	1.5	1.4	1.4	1.4	1.4	1.4	1.4
P 0.5	Grass 4	2.4	2.3	2.5	2.5	2.3	2.3	2.1
P 1.2	Grass 5	1.6	1.6	1.6	1.6	1.5	1.5	1.6
P 4.0	Grass 6	1.5	1.4	1.4	1.4	1.4	1.4	1.4

Table 7. Dependence of TVI on view angle.

V. SUMMARY

This study has particularly focused on the geometrical implications of a MRS pointable sensor. A variety of vegetation targets characteristic of both natural and agricultural canopies has been examined. Attention has further focused on the chlorophyll absorption band, 0.68 micrometers, and the infrared plateau, 0.80 micrometers. All combinations of sun and view angles between 5 and 85 degrees zenith for a range of relative azimuths have been simulated in an effort to examine geometrical dependencies arising from seasonal as well as latitudinal variations. The effects of three different atmospheres corresponding to a clear, medium, and heavy haze condition have been included. An extensive model data base has thus been generated and is included in the Appendices. These data may prove useful to other investigators for possible study of atmospheric correction procedures and sensor design questions.

From the results of the analyses performed by the present authors using this data base the following conclusions may be drawn:

1. For both low and high sun zenith angles, the percent change in scene radiance per degree change in the MRS pointing angle is of the order of .5 percent. The effect is somewhat less in the near infrared. Based on a threshold of a 10 percent change in scene radiance, a maximum pointing angle between 25 and 30 degrees is recommended for the visible wavelengths and 40 degrees for the infrared wavelengths.

2. For both low and high zenith view angles, the percent change in scene radiance per degree change in sun angle is of the order of 1 percent. The variability of lodgepole pine or coniferous forests appears to be greater than for agricultural or low lying canopies.
3. It should be possible to derive information from targets viewed under changes in sun angle between 10 to 15 degrees; to compare targets viewed under changes in view angle between 25 and 30 degrees, again, based on a 10 percent difference threshold in scene radiance.
4. The transformed vegetation index or TVI appears to be an effective normalization technique for removing view angle variations in the range between 0 and 45 degrees zenith angle. In our simulations, the TVI also appeared to be a valid indicator of leaf area index for both spherical and planophile canopies. It also appeared to remove the effect of canopy architecture, yielding approximately the same TVI values for a given LAI independent of the canopy structure.
5. Based on the TVI variation with view angle and other considerations, there does not appear to be a strong reason to extend the maximum pointing angle to 55 degrees. That is, the smaller viewing zenith angles yield the same relative differences in biomass discrimination.

In summary, the off-angle pointing of the MRS sensor should not cause appreciable difficulty between zenith viewing angles of 0 and 20 degrees. Between 20 and 40 degrees, the scene radiance variability

will increase, but may be acceptable. However, an operating range of 30 degrees under clear atmospheric conditions, is recommended for discrimination of low lying vegetation canopies.

The transformed vegetation index, as one indicator of a biomass discriminator, appears to normalize scene radiance variability with view angle for ranges between 0 and 40 degrees zenith angle. As far as target discrimination is concerned, there does not appear to be a strong rationale for extending the maximum pointing angle beyond 45 degrees.

Variation in scene radiance depends more strongly on changes in solar zenith angle than on changes in zenith viewing angle. In both cases it would appear reasonable to compare data sets acquired over differences of 10 to 15 degrees.

Finally, agricultural classes or rangeland areas should offer a reasonable test bed for MRS experiments. Difficulties appear to be greater in forest canopies.

The results of this study should be applicable to large fields of fairly homogeneous cover ranging from medium, LAI=1.5, to dense, LAI=4.0 cover. However, the reader is cautioned that the results may not be applicable to vegetation canopies where distinct horizontal structure exists, particularly at low leaf area indices.

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APPENDIX A

Bidirectional Reflectance Distribution Functions for Various Surface Types

<u>Table</u>	<u>Surface</u>
A.1	Spherical Grass Canopy LAI = .5
A.2	Spherical Grass Canopy LAI = 1.2
A.3	Spherical Grass Canopy LAI = 4.0
A.4	Planophile Grass Canopy LAI = .5
A.5	Planophile Grass Canopy LAI = 1.2
A.6	Planophile Grass Canopy LAI = 4.0
A.7	Lodgepole Pine Canopy LAI = 5.1
A.8	Pasture
A.9	Conifer

BRDF's defined in Tables A.1 through A.7 were derived with the Solar Radiation Vegetation Canopy model at Colorado State University. BRDF's defined in Tables A.8 and A.9 are from data published by Kriebel (1977).

Table A.1. Bidirectional reflectance distribution function for a spherical grass canopy with LAI = .50.

Wavelength = .68 μ m

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.113	.118	.115	.125	.091	.084	.099	.062	.176
15.0	.118	.115	.113	.122	.088	.085	.100	.064	.187
25.0	.117	.122	.118	.121	.102	.096	.085	.061	.173
35.0	.098	.107	.100	.102	.113	.115	.080	.066	.137
45.0	.106	.114	.100	.125	.100	.089	.082	.063	.178
55.0	.097	.096	.098	.090	.094	.086	.097	.085	.243
65.0	.082	.086	.092	.098	.084	.075	.107	.096	.278
75.0	.047	.049	.052	.055	.059	.073	.095	.142	.414
85.0	.046	.047	.051	.053	.060	.069	.088	.137	.404

Wavelength = .80 μ m

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.317	.328	.335	.358	.308	.319	.400	.435	1.243
15.0	.332	.330	.338	.361	.309	.329	.410	.450	1.282
25.0	.326	.337	.333	.350	.323	.341	.376	.428	1.224
35.0	.299	.315	.306	.321	.360	.393	.374	.460	1.315
45.0	.307	.324	.311	.357	.334	.357	.373	.445	1.270
55.0	.330	.346	.360	.340	.371	.402	.470	.579	1.659
65.0	.334	.343	.362	.380	.389	.403	.507	.648	1.875
75.0	.345	.364	.380	.397	.418	.510	.651	.939	2.739
85.0	.345	.348	.377	.388	.433	.481	.599	.960	2.685

Table A.2. Bidirectional reflectance distribution function for a spherical grass canopy with LAI = 1.2.

Wavelength = .68 μ m

LAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.067	.077	.086	.060	.067	.067	.071	.092	.258
15.0	.073	.061	.070	.066	.065	.070	.067	.097	.276
25.0	.078	.054	.052	.059	.076	.057	.079	.105	.300
35.0	.075	.060	.057	.056	.069	.057	.076	.107	.304
45.0	.068	.064	.058	.060	.066	.058	.073	.108	.308
55.0	.065	.073	.063	.061	.074	.071	.076	.118	.337
65.0	.056	.060	.055	.054	.064	.067	.083	.131	.337
75.0	.047	.047	.048	.052	.058	.069	.090	.141	.410
85.0	.046	.048	.048	.052	.055	.066	.085	.135	.396

Wavelength = .80 μ m

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.288	.322	.339	.306	.331	.373	.443	.651	1.849
15.0	.310	.289	.313	.329	.339	.393	.449	.682	1.963
25.0	.331	.291	.293	.323	.368	.393	.492	.740	2.123
35.0	.333	.307	.307	.319	.365	.398	.495	.752	2.152
45.0	.323	.317	.310	.325	.366	.394	.493	.756	2.172
55.0	.341	.355	.350	.348	.400	.432	.525	.810	2.330
65.0	.344	.349	.352	.362	.411	.470	.569	.895	2.583
75.0	.347	.346	.348	.369	.413	.486	.617	.933	2.737
85.0	.342	.355	.352	.376	.391	.459	.592	.925	2.713

Table A.3. Bidirectional reflectance distribution function for a spherical grass canopy with LAI = 4.0.

Wavelength = .68 μ m

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.047	.048	.051	.051	.059	.066	.085	.131	.366
15.0	.049	.050	.049	.052	.059	.070	.091	.142	.400
25.0	.052	.049	.047	.050	.056	.066	.086	.133	.372
35.0	.049	.046	.047	.052	.058	.070	.091	.142	.400
45.0	.049	.044	.046	.050	.056	.067	.088	.138	.391
55.0	.045	.046	.049	.052	.058	.070	.092	.143	.407
65.0	.042	.043	.045	.049	.055	.067	.090	.143	.412
75.0	.042	.043	.045	.048	.055	.066	.088	.140	.405
85.0	.039	.040	.042	.046	.053	.064	.086	.137	.401

Wavelength = .80 μ m

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.308	.312	.332	.353	.392	.456	.593	.920	2.586
15.0	.319	.329	.339	.363	.405	.483	.633	.990	2.799
25.0	.313	.322	.326	.350	.393	.460	.599	.933	2.633
35.0	.319	.316	.326	.362	.405	.482	.633	.990	2.809
45.0	.322	.308	.323	.348	.390	.466	.615	.967	2.760
55.0	.318	.319	.337	.359	.402	.483	.636	1.000	2.856
65.0	.293	.299	.314	.346	.385	.467	.625	.999	2.900
75.0	.291	.302	.312	.337	.381	.459	.613	.982	2.861
85.0	.277	.278	.293	.326	.368	.447	.602	.971	2.852

Table A.4. Bidirectional reflectance distribution function for a planophile grass canopy with LAI = .50.

Wavelength = .68um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.129	.117	.136	.137	.114	.127	.120	.129	.071
15.0	.129	.117	.136	.137	.114	.127	.120	.129	.071
25.0	.129	.117	.136	.137	.114	.127	.120	.129	.071
35.0	.129	.117	.136	.136	.114	.126	.120	.129	.071
45.0	.125	.128	.136	.124	.109	.126	.124	.127	.080
55.0	.125	.129	.136	.124	.109	.126	.124	.129	.079
65.0	.127	.135	.115	.114	.135	.124	.133	.126	.066
75.0	.125	.098	.112	.112	.117	.115	.101	.116	.101
85.0	.080	.082	.082	.081	.082	.085	.089	.101	.187

Wavelength = .80um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.378	.352	.383	.384	.355	.380	.376	.416	.489
15.0	.378	.352	.383	.384	.355	.380	.376	.416	.489
25.0	.378	.352	.383	.384	.355	.380	.376	.416	.489
35.0	.378	.352	.383	.384	.354	.379	.375	.416	.488
45.0	.389	.387	.400	.382	.361	.395	.400	.438	.540
55.0	.388	.386	.399	.381	.360	.394	.399	.436	.538
65.0	.365	.376	.339	.336	.376	.362	.383	.399	.454
75.0	.428	.389	.407	.406	.413	.427	.407	.465	.683
85.0	.551	.565	.563	.559	.564	.581	.608	.680	1.212

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Table A.5. Bidirectional reflectance distribution function for a planophile grass canopy with LAI = 1.2.

Wavelength = .68um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.087	.091	.092	.087	.085	.086	.097	.100	.150
15.0	.087	.091	.092	.087	.085	.086	.097	.100	.150
25.0	.087	.091	.092	.087	.085	.086	.097	.100	.150
35.0	.087	.091	.091	.087	.084	.085	.097	.100	.150
45.0	.087	.091	.091	.086	.084	.085	.096	.099	.150
55.0	.086	.090	.091	.086	.083	.085	.096	.099	.149
65.0	.083	.084	.092	.075	.096	.089	.084	.101	.134
75.0	.089	.078	.082	.090	.086	.080	.089	.101	.171
85.0	.077	.077	.079	.077	.078	.083	.085	.098	.188

Wavelength = .80um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.477	.485	.491	.474	.478	.487	.521	.582	1.020
15.0	.477	.485	.491	.474	.478	.487	.521	.592	1.020
25.0	.477	.485	.491	.474	.478	.487	.521	.592	1.020
35.0	.474	.482	.488	.470	.475	.484	.518	.578	1.017
45.0	.473	.481	.487	.469	.474	.483	.517	.577	1.016
55.0	.470	.478	.484	.466	.471	.480	.514	.574	1.013
65.0	.446	.458	.467	.436	.478	.468	.476	.555	.921
75.0	.511	.492	.503	.516	.510	.507	.546	.622	1.150
85.0	.528	.527	.542	.527	.535	.579	.578	.690	1.255

Table A.6. Bidirectional reflectance distribution function for a planophile grass canopy with LAI = 4.0.

Wavelength = .68um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.084	.080	.080	.081	.082	.083	.087	.099	.126
15.0	.084	.080	.080	.081	.082	.083	.087	.099	.126
25.0	.084	.080	.080	.081	.082	.083	.087	.099	.126
35.0	.086	.081	.081	.082	.083	.084	.088	.100	.126
45.0	.085	.081	.081	.082	.083	.084	.089	.104	.129
55.0	.081	.081	.081	.082	.082	.083	.088	.102	.122
65.0	.084	.084	.084	.085	.085	.087	.091	.103	.129
75.0	.081	.081	.081	.082	.082	.084	.088	.100	.129
85.0	.071	.071	.071	.072	.074	.075	.079	.094	.120

Wavelength = .80um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.550	.540	.538	.545	.553	.562	.536	.574	1.273
15.0	.550	.540	.538	.545	.553	.562	.536	.574	1.273
25.0	.550	.540	.538	.545	.553	.562	.536	.574	1.273
35.0	.557	.548	.547	.553	.562	.569	.592	.579	1.273
45.0	.553	.548	.550	.551	.558	.569	.561	.700	1.336
55.0	.548	.548	.550	.553	.556	.571	.597	.689	1.314
65.0	.567	.564	.564	.571	.571	.584	.613	.708	1.333
75.0	.547	.544	.546	.551	.551	.564	.593	.679	1.297
85.0	.487	.485	.484	.495	.507	.509	.539	.642	1.220

Table A.7. Bidirectional reflectance distribution function for a lodgepole pine canopy.

Wavelength = .68 μ m

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.036	.041	.039	.042	.047	.056	.072	.107	.289
15.0	.035	.036	.041	.041	.046	.057	.068	.102	.275
25.0	.034	.034	.033	.040	.041	.049	.064	.098	.269
35.0	.031	.032	.034	.038	.044	.053	.069	.106	.296
45.0	.029	.030	.032	.036	.041	.050	.066	.104	.292
55.0	.027	.028	.030	.034	.039	.049	.066	.105	.301
65.0	.026	.028	.030	.034	.039	.048	.065	.103	.296
75.0	.021	.022	.025	.029	.035	.044	.061	.100	.297
85.0	.020	.021	.024	.027	.032	.042	.059	.099	.294

Wavelength = .80 μ m

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.315	.342	.351	.376	.424	.509	.660	1.015	2.814
15.0	.310	.320	.339	.370	.414	.501	.638	.981	2.721
25.0	.288	.291	.297	.343	.377	.458	.610	.960	2.723
35.0	.281	.285	.306	.348	.395	.489	.650	1.023	2.923
45.0	.261	.274	.300	.338	.382	.466	.629	1.006	2.904
55.0	.253	.264	.288	.320	.369	.459	.629	1.022	2.994
65.0	.248	.258	.289	.321	.363	.457	.622	1.009	2.959
75.0	.205	.213	.252	.292	.335	.432	.603	1.003	3.013
85.0	.198	.204	.236	.284	.319	.422	.588	.989	3.000

Table A.8. Bidirectional reflectance distribution function for a pasture (Kriebel, 1977).

Wavelength = .606um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.046	.053	.054	.055	.054	.053	.050	.048	.056
15.0	.047	.054	.055	.058	.057	.056	.054	.051	.059
25.0	.046	.052	.055	.059	.059	.059	.057	.055	.064
35.0	.046	.046	.046	.054	.057	.060	.060	.060	.073
45.0	.044	.043	.042	.050	.056	.058	.062	.067	.083
55.0	.043	.043	.044	.048	.054	.058	.068	.081	.103
65.0	.043	.044	.046	.047	.052	.063	.077	.100	.138
75.0	.038	.037	.047	.053	.050	.056	.071	.096	.169
85.0	.069	.072	.084	.098	.112	.136	.167	.216	.316

Wavelength = .866um

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.384	.391	.391	.388	.399	.405	.407	.413	.433
15.0	.383	.392	.398	.392	.409	.418	.424	.438	.458
25.0	.382	.393	.409	.402	.424	.434	.447	.470	.488
35.0	.380	.394	.416	.416	.442	.458	.481	.502	.516
45.0	.382	.398	.420	.431	.475	.517	.543	.545	.544
55.0	.382	.400	.405	.429	.501	.586	.633	.636	.646
65.0	.349	.366	.368	.411	.488	.585	.692	.751	.796
75.0	.287	.308	.325	.349	.398	.495	.656	.852	1.058
85.0	.341	.379	.414	.435	.486	.590	.753	1.025	1.329

Table A.9. Bidirectional reflectance distribution function for a coniferous forest (Kriebel, 1977).

Wavelength = .606 μm

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.015	.016	.017	.018	.019	.020	.021	.026	.042
15.0	.015	.016	.017	.016	.018	.019	.019	.024	.038
25.0	.015	.016	.016	.014	.016	.016	.017	.022	.036
35.0	.015	.016	.014	.012	.016	.017	.017	.021	.037
45.0	.016	.016	.014	.010	.014	.017	.019	.022	.043
55.0	.016	.016	.014	.011	.014	.018	.022	.024	.053
65.0	.017	.016	.015	.013	.016	.021	.021	.022	.064
75.0	.020	.015	.014	.012	.015	.022	.025	.030	.142
85.0	.062	.057	.081	.130	.182	.237	.340	.471	.608

Wavelength = .866 μm

SOLAR ZENITH ANGLE	ZENITH VIEW ANGLE								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.0	.092	.090	.094	.097	.099	.102	.105	.107	.122
15.0	.095	.091	.093	.095	.099	.105	.108	.110	.125
25.0	.099	.093	.090	.092	.097	.108	.114	.116	.129
35.0	.103	.094	.089	.090	.097	.111	.120	.122	.137
45.0	.107	.096	.087	.090	.102	.117	.124	.128	.153
55.0	.111	.102	.092	.096	.112	.126	.130	.136	.177
65.0	.118	.111	.106	.112	.127	.140	.139	.144	.205
75.0	.146	.138	.143	.148	.156	.169	.186	.206	.320
85.0	.209	.254	.310	.362	.437	.546	.739	.932	1.135

APPENDIX B

Simulation Analysis Results

Total Radiance Calculations for:

Solar Zenith Angles = 5° , 15° , ..., 85°

Sensor Zenith View Angles = 5° , 15° , ..., 85°

Relative Sun-Sensor Azimuths = 0° , 60° , 90° , 120° , 180°

Atmospheric Visibilities = 23, 10 and 4 km

<u>Table</u>	<u>Surface Type</u>	<u>Wavelength</u>
B.1.1 - B.1.3	Spherical Grass Canopy, LAI = .5	.68 μ m
B.1.4 - B.1.6	"	.80 μ m
B.2.1 - B.2.3	Spherical Grass Canopy, LAI = 1.2	.68 μ m
B.2.4 - B.2.6	"	.80 μ m
B.3.1 - B.3.3	Spherical Grass Canopy, LAI = 4.0	.68 μ m
B.3.4 - B.3.6	"	.80 μ m
B.4.1 - B.4.3	Planophile Grass Canopy, LAI = .5	.68 μ m
B.4.4 - B.4.6	"	.80 μ m
B.5.1 - B.5.3	Planophile Grass Canopy, LAI = 1.2	.68 μ m
B.5.4 - B.5.6	"	.80 μ m
B.6.1 - B.6.3	Planophile Grass Canopy, LAI = 4.0	.68 μ m
B.6.4 - B.6.6	"	.80 μ m
B.7.1 - B.7.3	Lodgepole pine canopy, LAI = 5.1	.68 μ m
B.7.4 - B.7.6	"	.80 μ m

<u>Table</u>	<u>Surface Type</u>	<u>Wavelength</u>
B.8.1	Pasture	.606um
B.8.2	Pasture	.866um
B.9.1	Coniferous Forest	.606um
B.9.2	"	.866um

Table B.10.1 Comparison of field measured bidirectional reflectance with predicted sensor radiance for two wavelengths and three atmospheric visibilities.

Table B.10.2 Comparison of field measured bidirectional reflectance with predicted sensor radiance for two wavelengths and three atmospheric visibilities.

NOTE: For the total radiance matrices given in Tables B.1.1 - B.9.2, the rows represent solar zenith angles of 5°, 15°, ... 85°; the columns represent zenith view angles of 5°, 15°, ... 85°.

TABLE B.1.1 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=50.
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .259

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
5.978	5.804	5.449	5.676	4.265	3.936	4.390	3.312	6.379	
5.652	5.292	5.061	5.280	3.947	3.809	4.340	3.429	6.962	
5.084	5.101	4.845	4.868	4.165	3.973	3.751	3.536	7.423	
3.900	4.075	3.779	3.805	4.151	4.291	3.574	4.166	8.992	
3.562	3.705	3.285	3.967	3.376	3.324	3.792	4.970	11.840	
2.713	2.652	2.702	2.601	2.881	3.202	4.485	7.376	19.590	
1.841	1.904	2.062	2.321	2.501	3.176	5.752	11.996	36.305	
.970	1.038	1.210	1.575	2.258	3.970	8.480	22.931	77.401	
.691	.804	1.087	1.602	2.819	5.898	14.976	46.367	164.096	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
6.049	5.874	5.517	5.723	4.302	3.967	4.411	3.317	6.336	
5.722	5.411	5.156	5.359	4.014	3.855	4.348	3.345	6.619	
5.151	5.193	4.935	4.946	4.219	3.985	3.668	3.209	6.297	
3.943	4.146	3.852	3.861	4.173	4.229	3.311	3.303	6.565	
3.591	3.759	3.331	3.987	3.325	3.105	3.114	3.176	6.389	
2.735	2.684	2.713	2.557	2.698	2.652	3.154	3.607	7.155	
1.854	1.912	2.021	2.170	2.054	2.130	3.003	3.663	7.219	
.974	1.012	1.089	1.220	1.416	1.863	2.558	3.944	7.377	
.685	.734	.829	.985	1.244	1.630	2.315	3.513	6.044	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
6.133	5.959	5.585	5.769	4.338	3.998	4.432	3.321	6.293	
5.806	5.531	5.274	5.464	4.099	3.924	4.388	3.321	6.416	
5.217	5.308	5.071	5.071	4.326	4.069	3.702	3.120	5.869	
3.986	4.242	3.969	3.982	4.278	4.292	3.285	3.079	5.729	
3.621	3.829	3.421	4.082	3.391	3.124	3.015	2.785	5.167	
2.756	2.733	2.775	2.609	2.717	2.595	2.918	2.917	5.475	
1.866	1.937	2.045	2.161	1.995	1.948	2.543	2.687	4.973	
.977	1.009	1.063	1.135	1.241	1.485	1.870	2.574	4.719	
.679	.697	.741	.802	.907	1.070	1.351	1.897	3.231	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
6.250	6.063	5.653	5.818	4.379	4.028	4.454	3.325	6.249	
5.911	5.720	5.480	5.610	4.224	4.025	4.466	3.355	6.331	
5.284	5.511	5.330	5.293	4.538	4.248	3.849	3.206	5.798	
4.030	4.377	4.181	4.237	4.524	4.524	3.490	3.208	5.742	
3.654	3.934	3.607	4.309	3.646	3.379	3.248	2.972	5.189	
2.778	2.806	2.911	2.797	2.943	2.844	3.162	3.135	5.559	
1.879	1.984	2.138	2.301	2.171	2.157	2.785	2.911	5.122	
.981	1.030	1.112	1.213	1.364	1.649	2.069	2.804	4.974	
.674	.694	.754	.839	.991	1.208	1.562	2.222	3.843	
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX						
6.452	6.202	5.722	5.867	4.419	4.059	4.475	3.329	6.206	
6.051	6.466	5.951	5.916	4.426	4.184	4.594	3.450	6.358	
5.351	5.983	6.467	6.122	5.073	4.633	4.162	3.474	5.998	
4.075	4.672	5.006	5.871	5.747	5.370	4.136	3.785	6.274	
3.687	4.111	4.107	5.517	5.955	5.193	4.576	4.074	6.254	
2.799	2.925	3.227	3.566	4.725	6.288	6.055	5.410	7.695	
1.891	2.062	2.350	2.801	3.354	5.008	8.625	9.348	10.683	
.995	1.077	1.256	1.569	2.189	3.710	7.602	15.662	19.716	
.668	.722	.863	1.142	1.742	3.171	7.269	20.774	59.271	

TABLE B.1.2 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=.50.
 WAVELENGTH = .68 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .429

AZINUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
6.526	5.927	5.360	5.434	4.058	3.699	4.043	3.058	5.769
5.791	5.221	4.884	5.006	3.739	3.582	4.024	3.231	6.381
5.036	4.930	4.624	4.600	3.932	3.747	3.571	3.465	6.950
3.827	3.923	3.615	3.624	3.935	4.082	3.539	4.306	8.650
3.454	3.553	3.155	3.783	3.277	3.323	3.992	5.493	11.883
2.641	2.575	2.630	2.575	2.918	3.435	5.027	8.656	20.466
1.831	1.897	2.077	2.396	2.764	3.771	7.075	15.047	39.365
1.042	1.136	1.370	1.885	2.849	5.249	11.489	30.041	85.934
.821	.984	1.391	2.138	3.922	8.429	21.340	62.499	186.207
AZINUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
6.680	6.064	5.485	5.508	4.108	3.735	4.063	3.054	5.716
5.929	5.441	5.037	5.117	3.820	3.625	4.015	3.107	6.010
5.160	5.081	4.752	4.697	3.985	3.738	3.434	3.030	5.743
3.898	4.026	3.707	3.681	3.939	3.967	3.155	3.176	6.043
3.498	3.623	3.203	3.789	3.179	2.989	3.027	3.143	5.941
2.670	2.610	2.629	2.491	2.632	2.621	3.136	3.654	6.721
1.845	1.898	2.003	2.159	2.089	2.227	3.121	3.842	6.866
1.045	1.090	1.183	1.345	1.583	2.106	2.874	4.275	7.079
.811	.878	1.002	1.210	1.546	2.028	2.838	4.059	5.940
AZINUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
6.858	6.235	5.610	5.583	4.159	3.772	4.082	3.049	5.664
6.099	5.662	5.235	5.274	3.931	3.702	4.044	3.051	5.780
5.284	5.276	4.966	4.871	4.115	3.823	3.443	2.883	5.270
3.969	4.175	3.874	3.838	4.058	4.016	3.078	2.852	5.198
3.542	3.721	3.319	3.901	3.237	2.974	2.949	2.608	4.621
2.698	2.672	2.699	2.537	2.625	2.501	2.772	2.734	4.911
1.859	1.923	2.021	2.123	1.975	1.936	2.453	2.557	4.450
1.048	1.078	1.132	1.204	1.309	1.542	1.896	2.484	4.223
.802	.822	.869	.937	1.050	1.219	1.495	1.969	2.913
AZINUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
7.102	6.451	5.734	5.661	4.214	3.808	4.102	3.045	5.611
6.317	6.096	5.615	5.507	4.108	3.826	4.122	3.064	5.669
5.407	5.653	5.426	5.224	4.422	4.051	3.599	2.938	5.150
4.043	4.397	4.217	4.232	4.406	4.312	3.300	2.945	5.084
3.590	3.878	3.601	4.231	3.586	3.294	3.102	2.761	4.562
2.726	2.772	2.891	2.797	2.924	2.807	3.038	2.924	4.911
1.874	1.981	2.140	2.301	2.194	2.186	2.722	2.764	4.523
1.051	1.101	1.189	1.296	1.459	1.740	2.125	2.724	4.442
.792	.814	.885	.986	1.167	1.414	1.786	2.416	3.635
AZINUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX					
7.509	6.749	5.860	5.739	4.270	3.944	4.122	3.041	5.639
6.617	7.590	6.578	6.065	4.28	4.043	4.269	3.146	5.639
5.532	6.623	7.748	6.855	5.356	4.632	4.002	3.219	5.290
4.117	4.948	5.858	7.493	6.735	5.737	4.234	3.634	5.556
3.638	4.175	4.511	6.572	8.100	6.656	5.265	4.257	5.658
2.755	2.952	3.413	4.175	6.320	9.415	8.257	6.453	7.454
1.898	2.090	2.462	3.133	4.314	7.560	13.664	12.122	11.231
1.054	1.160	1.395	1.957	2.862	5.453	12.371	25.582	26.022
.783	.854	1.046	1.468	2.433	4.365	11.974	34.491	35.237

TABLE B.1.3 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=.50.
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .809

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
8.376	6.524	5.374	5.107	3.762	3.358	3.583	2.750	5.257	
6.419	5.260	4.654	4.585	3.421	3.244	3.595	2.970	5.875	
5.122	4.709	4.281	4.171	3.565	3.406	3.308	3.312	6.495	
3.779	3.696	3.352	3.328	3.589	3.759	3.452	4.332	8.248	
3.306	3.309	2.943	3.478	3.110	3.296	4.186	5.849	11.676	
2.539	2.455	2.510	2.526	2.958	3.735	5.629	9.664	20.685	
1.828	1.889	2.100	2.508	3.148	4.579	8.615	17.612	40.791	
1.178	1.308	1.635	2.373	3.728	7.003	15.054	36.207	90.487	
1.058	1.294	1.889	2.979	5.564	11.914	29.007	77.309	200.070	
AZIMUTH = 50.00 DEGREES			TOTAL RADIANCE MATRIX						
8.781	6.957	5.655	5.254	3.847	3.409	3.603	2.740	5.200	
6.754	5.761	4.961	4.776	3.538	3.292	3.568	2.813	5.495	
5.406	5.015	4.506	4.316	3.627	3.374	3.110	2.789	5.261	
3.926	3.882	3.495	3.399	3.576	3.577	2.927	2.979	5.572	
3.388	3.420	3.004	3.471	2.948	2.806	2.885	3.031	5.513	
2.586	2.503	2.498	2.385	2.524	2.561	3.075	3.607	6.286	
1.850	1.887	1.979	2.141	2.137	2.351	3.228	3.915	6.474	
1.183	1.236	1.346	1.549	1.836	2.438	3.228	4.487	6.715	
1.046	1.136	1.299	1.579	2.011	2.589	3.472	4.526	5.764	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
9.240	7.277	5.937	5.402	3.932	3.459	3.624	2.730	5.143	
7.176	6.263	5.371	5.064	3.716	3.394	3.592	2.734	5.253	
5.690	5.425	4.922	4.612	3.816	3.476	3.101	2.597	4.772	
4.073	4.166	3.787	3.650	3.740	3.622	2.801	2.577	4.704	
3.470	3.592	3.137	3.634	3.013	2.761	2.624	2.331	4.161	
2.634	2.600	2.599	2.441	2.496	2.370	2.573	2.504	4.435	
1.872	1.924	2.001	2.077	1.957	1.926	2.327	2.383	4.003	
1.188	1.217	1.267	1.335	1.431	1.635	1.926	2.359	3.794	
1.034	1.056	1.107	1.181	1.298	1.463	1.702	2.046	2.657	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
9.856	7.831	6.218	5.583	4.023	3.510	3.645	2.720	5.037	
7.734	7.322	6.229	5.520	4.019	3.576	3.683	2.734	5.130	
5.973	6.287	5.930	5.302	4.359	3.824	3.295	2.640	4.631	
4.223	4.620	4.476	4.401	4.341	4.077	3.086	2.660	4.567	
3.557	3.885	3.721	4.229	3.596	3.255	2.958	2.545	4.083	
2.681	2.774	2.936	2.888	2.989	2.836	2.938	2.731	4.428	
1.894	2.017	2.197	2.368	2.307	2.312	2.721	2.665	4.101	
1.194	1.255	1.363	1.488	1.682	1.968	2.304	2.740	4.111	
1.021	1.055	1.155	1.276	1.539	1.841	2.241	2.805	3.667	
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX						
10.822	8.615	6.502	5.706	4.115	3.561	3.665	2.710	5.030	
8.523	11.091	8.640	6.767	4.636	3.928	3.880	2.815	5.107	
6.259	8.730	11.667	9.215	6.344	4.881	3.905	2.977	4.754	
4.374	5.887	8.461	12.247	9.712	6.967	4.689	3.610	5.068	
3.645	4.503	5.752	9.750	14.148	10.699	7.121	4.899	5.415	
2.728	3.112	4.005	5.906	10.775	17.749	13.905	8.764	7.733	
1.915	2.206	2.809	4.071	6.383	14.232	26.132	20.601	14.345	
1.199	1.355	1.741	2.581	4.563	9.913	23.768	46.721	38.634	
1.009	1.136	1.457	2.219	4.025	8.685	22.013	60.503	125.473	

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TABLE B.1.4 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=.50.
WAVELENGTH = .80 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
OPTICAL DEPTH = .222

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
10.687	10.860	10.915	11.465	9.720	9.797	11.686	11.639	25.439	
10.684	10.481	10.598	11.150	9.417	9.773	11.632	11.782	25.856	
9.755	9.970	9.754	10.120	9.218	9.522	10.141	10.836	24.100	
8.058	8.401	8.097	8.403	9.287	9.958	9.335	11.062	24.901	
7.106	7.436	7.102	8.071	7.529	7.597	9.485	10.343	24.277	
6.170	6.432	6.666	6.312	6.907	7.629	9.237	12.587	31.803	
4.608	4.726	5.001	5.312	5.639	6.293	8.927	14.978	43.075	
2.947	3.131	3.344	3.688	4.280	6.087	10.283	22.906	74.997	
1.102	1.192	1.454	1.855	2.865	5.343	12.665	37.641	131.817	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
10.715	10.892	10.948	11.488	9.737	9.810	11.693	11.633	25.395	
10.715	10.538	10.644	11.188	9.446	9.788	11.620	11.703	25.565	
9.787	10.016	9.796	10.155	9.236	9.509	10.061	10.572	23.181	
8.079	8.435	8.129	8.421	9.281	9.893	9.123	10.396	22.885	
7.120	7.460	7.117	8.065	7.474	7.421	7.971	8.944	19.696	
6.180	6.443	6.659	6.265	6.760	7.215	8.219	9.611	21.296	
4.613	4.722	4.961	5.191	5.304	5.498	6.797	8.347	18.655	
2.946	3.105	3.249	3.422	3.641	4.460	5.641	7.832	17.536	
1.096	1.136	1.257	1.379	1.633	1.966	2.621	3.889	7.902	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
10.748	10.928	10.981	11.511	9.755	9.823	11.700	11.628	25.351	
10.752	10.596	10.703	11.239	9.485	9.815	11.627	11.662	25.379	
9.819	10.072	9.863	10.213	9.282	9.538	10.054	10.473	22.805	
8.100	8.482	8.184	8.475	9.321	9.903	9.069	10.191	22.223	
7.134	7.492	7.156	8.103	7.489	7.398	7.861	8.612	19.673	
6.189	6.463	6.681	6.275	6.743	7.140	8.009	9.054	19.897	
4.617	4.728	4.960	5.163	5.235	5.336	6.426	7.574	16.781	
2.945	3.094	3.216	3.343	3.493	4.160	5.103	6.748	15.314	
1.089	1.102	1.182	1.230	1.367	1.526	1.861	2.595	5.541	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
10.794	10.971	11.013	11.536	9.774	9.837	11.707	11.622	25.307	
10.795	10.693	10.802	11.311	9.545	9.861	11.655	11.657	25.260	
9.851	10.170	9.989	10.323	9.385	9.620	10.111	10.483	22.685	
8.122	8.548	8.289	8.600	9.438	10.007	9.150	10.212	22.094	
7.150	7.543	7.246	8.210	7.606	7.509	7.949	8.654	18.564	
6.199	6.496	6.744	6.360	6.842	7.243	8.096	9.100	19.807	
4.621	4.746	4.998	5.220	5.303	5.413	6.506	7.613	16.714	
2.945	3.096	3.228	3.364	3.530	4.207	5.151	6.780	15.297	
1.082	1.090	1.173	1.226	1.379	1.557	1.913	2.686	5.735	
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX									
10.873	11.026	11.047	11.560	9.794	9.850	11.714	11.616	25.263	
10.851	10.974	11.002	11.459	9.646	9.938	11.712	11.689	25.253	
9.883	10.370	10.457	10.692	9.645	9.910	10.260	10.599	22.743	
8.145	8.690	8.655	9.293	9.993	10.421	9.469	10.487	22.331	
7.166	7.630	7.488	8.757	9.600	9.341	9.601	9.201	19.094	
6.208	6.553	6.899	6.733	7.657	8.738	9.435	10.231	20.922	
4.626	4.781	5.098	5.465	5.380	6.729	9.063	10.174	19.308	
2.944	3.114	3.292	3.535	3.938	5.221	7.747	12.541	22.669	
1.075	1.096	1.218	1.373	1.765	2.539	4.297	12.022	33.235	

TABLE B.1.5BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=.50.
 WAVELENGTH = .90 MICROMETERS, VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .361

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
10.523	10.486	10.400	10.808	9.081	9.036	10.579	10.328	23.843	
10.333	10.017	10.042	10.480	8.785	9.015	10.551	10.511	24.300	
9.346	9.478	9.218	9.504	8.601	8.801	9.261	9.792	22.748	
7.689	7.969	7.649	7.900	8.676	9.237	8.628	10.217	23.717	
6.759	7.046	6.714	7.599	7.081	7.154	8.055	9.975	23.572	
5.860	6.097	6.310	5.986	6.567	7.335	9.044	12.774	31.739	
4.384	4.499	4.772	5.103	5.523	6.375	9.449	16.687	44.763	
2.826	3.019	3.265	3.701	4.481	6.730	12.119	27.738	80.567	
1.123	1.250	1.595	2.168	3.590	7.116	17.242	49.340	145.828	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
10.585	10.549	10.461	10.846	9.106	9.053	10.585	10.317	23.793	
10.396	10.124	10.119	10.535	8.822	9.028	10.526	10.400	23.984	
9.406	9.554	9.281	9.548	8.617	8.773	9.140	9.441	21.753	
7.724	8.021	7.691	7.918	8.656	9.132	8.324	9.337	21.530	
6.781	7.078	6.729	7.582	6.991	6.892	7.324	8.124	18.567	
5.873	6.108	6.293	5.908	6.344	6.727	7.596	8.811	20.185	
4.390	4.489	4.707	4.919	5.021	5.207	6.404	7.806	17.772	
2.824	2.978	3.120	3.300	3.527	4.332	5.456	7.490	16.847	
1.112	1.166	1.303	1.460	1.761	2.157	2.890	4.150	7.692	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
10.655	10.625	10.523	10.884	9.131	9.070	10.591	10.305	23.743	
10.472	10.231	10.219	10.614	8.876	9.060	10.526	10.337	23.777	
9.467	9.651	9.389	9.634	8.676	8.802	9.115	9.298	21.340	
7.760	8.095	7.773	7.992	8.704	9.132	8.232	9.054	20.809	
6.803	7.125	6.781	7.628	6.993	6.343	7.154	7.676	17.456	
5.886	6.134	6.319	5.912	6.305	6.604	7.239	8.069	18.657	
4.395	4.494	4.699	4.869	4.910	4.963	5.373	6.782	15.741	
2.822	2.958	3.068	3.178	3.304	3.891	4.694	6.061	14.442	
1.102	1.116	1.192	1.242	1.373	1.527	1.832	2.465	5.140	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
10.751	10.717	10.583	10.924	9.159	9.086	10.597	10.294	23.693	
10.564	10.428	10.403	10.732	8.965	9.119	10.555	10.318	23.681	
9.526	9.835	9.616	9.813	8.830	8.912	9.179	9.291	21.194	
7.798	8.207	7.947	8.190	8.877	9.272	8.324	9.054	20.645	
6.827	7.204	6.923	7.791	7.168	6.991	7.254	7.699	17.309	
5.900	6.182	6.411	6.036	6.444	6.738	7.387	8.099	18.539	
4.400	4.517	4.750	4.946	5.000	5.059	5.965	6.809	15.645	
2.820	2.960	3.082	3.203	3.352	3.951	4.753	6.095	14.423	
1.092	1.098	1.179	1.239	1.398	1.583	1.926	2.624	5.440	
AZIMUTH = 159.00 DEGREES TOTAL RADIANCE MATRIX									
10.906	10.839	10.644	10.964	9.187	9.103	10.603	10.282	23.643	
10.687	11.021	10.821	11.005	9.128	9.228	10.624	10.345	23.618	
9.587	10.255	10.581	10.550	9.293	9.209	9.382	9.420	21.229	
7.835	8.475	8.687	9.586	9.951	9.985	9.805	9.405	20.371	
6.851	7.354	7.370	8.868	9.133	8.564	8.347	8.482	17.393	
5.913	6.272	6.675	6.717	8.024	9.649	9.863	9.920	19.945	
4.405	4.568	4.911	5.367	6.055	7.591	10.858	11.365	19.341	
2.818	2.983	3.180	3.486	4.070	5.831	9.693	16.664	25.839	
1.082	1.110	1.255	1.490	2.082	3.469	7.434	19.395	47.948	

TABLE B.1.6 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=.50.
 WAVELENGTH = .90 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .689

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
10.713	10.012	9.547	9.664	7.989	7.803	8.979	8.861	23.139	
9.898	9.243	9.054	9.285	7.691	7.778	8.982	9.081	23.624	
8.675	8.595	8.242	8.393	7.526	7.620	7.974	8.600	22.100	
7.038	7.178	6.827	6.990	7.609	8.051	7.586	9.228	23.155	
6.127	6.322	5.997	6.742	6.295	6.418	7.400	9.481	23.153	
5.287	5.471	5.651	5.390	5.962	6.832	8.710	12.840	31.735	
3.972	4.075	4.346	4.719	5.301	6.468	10.102	18.314	45.562	
2.609	2.812	3.118	3.711	4.796	7.696	14.562	32.547	83.457	
1.180	1.368	1.854	2.709	4.774	9.811	23.388	61.338	153.566	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
10.892	10.178	9.695	9.744	8.035	7.829	8.986	8.845	23.087	
10.064	9.506	9.221	9.389	7.751	7.794	8.943	8.940	23.301	
8.824	8.762	8.364	8.468	7.546	7.573	7.901	8.163	21.079	
7.118	7.279	6.900	7.016	7.572	7.889	7.157	8.133	20.907	
6.171	6.379	6.019	6.712	6.150	6.023	6.373	7.174	17.979	
5.312	5.490	5.622	5.264	5.615	5.921	6.676	7.876	19.722	
3.981	4.060	4.241	4.428	4.525	4.721	5.807	7.142	17.387	
2.608	2.748	2.888	3.080	3.324	4.106	5.152	7.032	16.710	
1.166	1.239	1.400	1.614	1.981	2.456	3.251	4.381	7.440	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
11.092	10.384	9.844	9.825	8.082	7.956	8.993	8.830	23.035	
10.271	9.769	9.443	9.546	7.847	7.842	8.938	8.858	23.088	
8.973	8.983	8.591	8.628	7.643	7.613	7.760	7.981	20.656	
7.198	7.434	7.058	7.147	7.648	7.882	7.022	7.777	20.168	
6.215	6.471	6.113	6.788	6.157	5.946	6.130	6.517	16.841	
5.336	5.538	5.665	5.269	5.553	5.735	6.244	6.956	19.170	
3.990	4.069	4.231	4.349	4.353	4.359	5.068	5.379	15.309	
2.606	2.719	2.808	2.894	2.987	3.458	4.101	5.273	14.250	
1.152	1.168	1.237	1.289	1.410	1.554	1.815	2.326	4.828	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
11.354	10.645	9.991	9.909	8.132	7.982	9.000	8.814	22.983	
10.534	10.293	9.894	9.797	8.013	7.939	8.978	8.831	22.967	
9.121	9.436	9.128	9.008	7.941	7.799	7.852	7.967	20.503	
7.280	7.682	7.435	7.559	7.976	8.125	7.159	7.775	19.999	
6.263	6.631	6.405	7.112	6.473	6.205	6.285	6.652	16.696	
5.361	5.630	5.845	5.508	5.812	5.972	6.408	7.017	18.058	
4.000	4.113	4.328	4.495	4.524	4.540	5.240	5.960	15.255	
2.604	2.728	2.843	2.952	3.094	3.600	4.252	5.407	14.333	
1.139	1.150	1.239	1.322	1.512	1.730	2.080	2.723	5.404	
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX						
11.744	11.003	10.140	9.992	8.183	7.908	9.007	8.798	22.931	
10.894	11.929	11.047	10.455	8.355	8.134	9.082	8.861	22.920	
9.271	10.603	11.730	10.943	9.007	8.389	8.192	8.145	20.541	
7.363	8.347	9.401	11.218	10.684	9.696	8.064	8.316	20.271	
6.311	6.969	7.486	9.984	11.480	10.017	8.587	8.014	17.481	
5.386	5.816	6.433	7.131	9.778	13.159	12.136	10.569	20.170	
4.009	4.214	4.665	5.439	7.015	10.716	16.771	15.635	21.355	
2.602	2.776	3.047	3.567	4.724	7.975	15.717	28.010	34.091	
1.125	1.186	1.408	1.870	3.015	5.885	13.947	36.309	74.637	

TABLE B.2.1 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY WITH LAI = 1.2
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .259

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
4.173	4.200	4.322	3.186	3.366	3.321	3.469	4.216	3.273
3.941	3.248	3.444	3.202	3.113	3.284	3.251	4.592	3.957
3.695	2.690	2.524	2.714	3.281	2.693	3.565	4.739	10.090
3.163	2.575	2.418	2.369	2.904	2.575	3.463	5.176	11.207
2.517	2.335	2.145	2.222	2.483	2.539	3.577	5.921	13.951
2.008	2.146	1.938	1.977	2.460	2.897	4.082	7.937	20.323
1.427	1.491	1.479	1.636	2.197	3.058	5.419	12.427	36.366
.970	1.019	1.173	1.548	2.249	3.935	8.439	22.924	77.378
.591	.807	1.080	1.599	2.809	5.891	14.972	46.365	164.084
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
4.245	4.270	4.390	3.233	3.403	3.352	3.491	4.220	3.230
4.011	3.367	3.539	3.281	3.180	3.329	3.259	4.308	3.614
3.762	2.782	2.614	2.793	3.335	2.705	3.483	4.712	3.964
3.206	2.647	2.491	2.425	2.825	2.513	3.200	4.313	3.780
2.547	2.389	2.191	2.242	2.432	2.320	2.999	4.127	3.500
2.029	2.178	1.949	1.933	2.277	2.347	2.752	4.168	3.388
1.440	1.499	1.438	1.485	1.750	2.012	2.670	4.094	2.790
.974	.993	1.052	1.192	1.407	1.829	2.517	3.937	2.354
.685	.736	.821	.982	1.234	1.623	2.310	3.511	2.031
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
4.328	4.354	4.459	3.290	3.439	3.393	3.512	4.224	3.187
4.095	3.487	3.658	3.386	3.265	3.398	3.299	4.284	3.411
3.828	2.897	2.750	2.917	3.442	2.799	3.517	4.323	3.536
3.249	2.743	2.608	2.546	2.930	2.576	3.174	4.088	3.004
2.577	2.459	2.281	2.337	2.499	2.339	2.801	3.735	2.278
2.050	2.227	2.011	1.935	2.295	2.289	2.515	3.473	2.108
1.452	1.524	1.462	1.476	1.690	1.850	2.209	3.113	1.534
.977	.990	1.026	1.103	1.232	1.450	1.829	2.567	1.191
.679	.700	.733	.799	.998	1.063	1.347	1.893	0.918
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
4.445	4.458	4.526	3.328	3.479	3.413	3.534	4.229	3.143
4.199	3.705	3.864	3.531	3.390	3.499	3.377	4.318	3.329
3.895	3.101	3.009	3.140	3.654	2.969	3.664	4.409	3.465
3.294	2.877	2.821	2.800	3.176	2.808	3.379	4.217	2.957
2.609	2.564	2.467	2.564	2.754	2.594	3.034	3.923	2.500
2.072	2.301	2.148	2.173	2.522	2.538	2.759	3.696	2.191
1.465	1.571	1.555	1.616	1.666	2.039	2.452	3.342	1.463
.981	1.011	1.075	1.126	1.355	1.615	2.028	2.797	1.191
.674	.697	.747	.836	.981	1.201	1.557	2.236	0.931
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX					
4.547	4.597	4.596	3.378	3.520	3.444	3.558	4.233	3.100
4.339	4.421	4.335	3.837	3.592	3.659	3.505	4.413	3.353
3.962	3.573	4.146	3.968	4.188	3.353	3.977	4.671	3.664
3.338	3.172	3.645	4.435	4.379	3.654	4.035	4.794	3.439
2.642	2.741	2.967	3.772	3.962	4.407	4.362	3.925	3.166
2.093	2.420	2.464	2.942	4.305	5.762	5.652	5.971	3.126
1.477	1.649	1.766	2.116	3.050	4.390	5.291	5.179	10.144
.935	1.068	1.219	1.542	2.180	3.676	7.561	15.554	19.144
.666	.725	.855	1.139	1.732	3.163	7.264	20.771	35.155

TABLE B.2.2 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY WITH LAI = 1.2
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .429

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
4.855	4.444	4.322	3.156	3.244	3.150	3.238	3.833	7.541
4.207	3.332	3.396	3.105	2.984	3.113	3.071	4.057	8.249
3.751	2.704	2.489	2.632	3.131	2.606	3.409	4.496	9.445
3.146	2.539	2.365	2.312	2.716	2.553	3.442	5.171	10.722
2.490	2.291	2.109	2.192	2.471	2.624	3.804	6.306	13.853
1.991	2.111	1.932	2.008	2.538	3.163	4.676	9.134	21.616
1.451	1.519	1.546	1.776	2.490	3.667	6.786	15.413	39.866
1.042	1.120	1.337	1.860	2.841	5.219	11.454	30.035	85.913
.821	.987	1.384	2.135	3.914	8.423	21.336	62.498	186.195
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
5.010	4.581	4.447	3.230	3.294	3.186	3.258	3.829	7.489
4.345	3.552	3.549	3.216	3.064	3.156	3.062	3.933	7.877
3.875	2.855	2.617	2.729	3.185	2.507	3.272	4.061	8.239
3.217	2.643	2.457	2.369	2.720	2.438	3.057	4.041	8.114
2.534	2.361	2.157	2.198	2.373	2.289	2.840	3.956	7.912
2.020	2.146	1.930	1.923	2.252	2.350	2.796	4.133	7.871
1.466	1.520	1.472	1.539	1.816	2.123	2.833	4.209	7.387
1.045	1.074	1.150	1.320	1.575	2.076	2.839	4.269	7.058
.811	.880	.995	1.208	1.533	2.022	2.834	4.057	5.929
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
5.187	4.752	4.572	3.305	3.345	3.223	3.277	3.824	7.436
4.515	3.773	3.747	3.373	3.176	3.233	3.091	3.877	7.647
3.999	3.050	2.831	2.902	3.314	2.682	3.281	3.914	7.766
3.288	2.791	2.624	2.526	2.839	2.487	2.981	3.717	7.269
2.578	2.459	2.272	2.309	2.431	2.275	2.662	3.421	6.592
2.048	2.207	2.000	1.969	2.245	2.230	2.422	3.213	6.061
1.480	1.546	1.490	1.503	1.702	1.832	2.164	2.923	4.871
1.048	1.061	1.099	1.180	1.302	1.512	1.851	2.478	4.202
.802	.824	.862	.934	1.041	1.213	1.491	1.967	2.902
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
5.432	4.968	4.697	3.383	3.400	3.259	3.297	3.820	7.384
4.732	4.207	4.127	3.606	3.353	3.357	3.169	3.890	7.536
4.122	3.428	3.291	3.256	3.622	2.910	3.437	3.970	7.945
3.362	3.013	2.967	2.920	3.187	2.782	3.203	3.810	7.155
2.626	2.616	2.555	2.639	2.779	2.595	2.914	3.574	6.533
2.077	2.308	2.192	2.229	2.544	2.536	2.687	3.403	6.060
1.495	1.604	1.609	1.681	1.920	2.082	2.434	3.130	5.044
1.051	1.084	1.156	1.271	1.451	1.710	2.090	2.718	4.421
.792	.816	.878	.984	1.139	1.408	1.782	2.415	3.924
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX					
5.837	5.266	4.823	3.461	3.456	3.295	3.317	3.814	7.331
5.033	5.701	5.090	4.164	3.673	3.574	3.316	3.902	7.326
4.247	4.397	5.614	4.886	4.555	3.491	3.840	4.250	7.735
3.436	3.565	4.607	6.181	5.516	4.207	4.137	4.499	7.627
2.674	2.913	3.465	4.981	7.293	5.957	5.078	5.079	7.629
2.105	2.488	2.714	3.607	5.940	9.144	7.907	6.932	8.504
1.509	1.712	1.931	2.513	4.041	7.456	13.375	12.488	11.002
1.054	1.143	1.362	1.833	2.854	5.428	12.336	23.576	26.171
.783	.857	1.039	1.466	2.425	4.359	11.970	34.467	45.136

TABLE B.2.3 BROF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY WITH LAI = 1.2
 WAVELENGTH = .68 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .309

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
6.938	5.250	4.488	3.179	3.082	2.906	2.925	3.400	6.938	
5.056	3.640	3.385	2.977	2.790	2.858	2.817	3.662	7.647	
4.018	2.802	2.463	2.508	2.897	2.467	3.176	4.176	8.862	
3.196	2.514	2.290	2.223	2.573	2.503	3.373	5.055	10.210	
2.483	2.234	2.056	2.141	2.441	2.724	4.034	6.526	13.537	
1.987	2.061	1.922	2.052	2.645	3.514	5.346	10.061	21.768	
1.509	1.573	1.657	1.995	2.925	4.495	8.385	17.913	41.263	
1.178	1.294	1.608	2.353	3.722	6.979	15.027	36.202	90.466	
1.058	1.296	1.884	2.977	5.558	11.910	29.004	77.308	200.061	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
7.343	5.583	4.769	3.327	3.167	2.956	2.946	3.390	6.882	
5.390	4.141	3.692	3.168	2.907	2.906	2.790	3.505	7.257	
4.301	3.109	2.688	2.633	2.959	2.435	2.973	3.552	7.627	
3.342	2.700	2.433	2.294	2.560	2.321	2.348	3.702	7.533	
2.565	2.345	2.118	2.134	2.279	2.234	2.733	3.709	7.374	
2.034	2.109	1.909	1.911	2.210	2.340	2.792	4.004	7.369	
1.531	1.570	1.536	1.629	1.914	2.267	2.997	4.216	6.961	
1.183	1.222	1.319	1.529	1.829	2.414	3.201	4.482	6.696	
1.046	1.137	1.294	1.577	2.005	2.585	3.469	4.525	6.754	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
7.902	6.004	5.051	3.474	3.251	3.007	2.966	3.360	6.825	
5.813	4.643	4.102	3.456	3.085	3.007	2.814	3.426	7.026	
4.585	3.518	3.104	2.949	3.149	2.537	2.968	3.461	7.139	
3.489	2.994	2.725	2.545	2.725	2.366	2.722	3.300	6.665	
2.646	2.516	2.300	2.296	2.343	2.189	2.470	3.059	6.000	
2.082	2.206	2.011	1.967	2.132	2.149	2.290	2.901	5.513	
1.553	1.607	1.558	1.565	1.734	1.842	2.096	2.664	4.439	
1.186	1.203	1.240	1.316	1.424	1.611	1.899	2.354	3.705	
1.034	1.053	1.102	1.179	1.291	1.458	1.700	2.045	2.610	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
8.419	6.557	5.332	3.626	3.343	3.058	2.987	3.370	6.762	
6.370	5.702	4.940	3.912	3.398	3.190	2.906	3.427	6.900	
4.868	4.381	4.112	3.640	3.691	2.385	3.163	3.503	6.948	
3.640	3.438	3.413	3.296	3.325	2.321	3.007	3.333	6.526	
2.734	2.810	2.835	2.891	2.927	2.683	2.806	3.223	6.243	
2.129	2.380	2.347	2.415	2.675	2.616	2.656	3.129	5.511	
1.575	1.700	1.754	1.856	2.083	2.228	2.490	2.767	4.533	
1.194	1.241	1.336	1.468	1.676	1.944	2.276	2.736	4.092	
1.021	1.057	1.150	1.294	1.533	1.837	2.236	2.803	3.637	
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX						
9.384	7.341	5.616	3.778	3.435	3.109	3.008	3.360	6.712	
7.160	6.471	7.371	5.159	4.006	3.542	3.103	3.507	6.379	
5.154	6.823	9.849	7.553	5.676	3.942	3.773	3.841	7.121	
3.791	4.704	7.399	11.142	8.696	5.711	4.610	4.333	7.000	
2.821	3.428	4.866	8.412	13.479	10.127	6.969	5.576	7.276	
2.177	2.719	3.416	5.433	10.462	17.529	13.622	9.381	9.015	
1.597	1.390	2.366	3.553	6.660	14.148	25.901	20.902	14.111	
1.199	1.341	1.714	2.561	4.556	9.794	23.741	46.736	38.127	
1.009	1.137	1.482	2.213	4.019	6.680	22.010	60.512	101.166	

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TABLE B.2.4 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY WITH LAI = 1.2
 WAVELENGTH = .80 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .222

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
9.766	10.670	11.041	9.845	10.423	11.401	12.904	17.161	38.044	
10.006	9.222	9.834	10.183	10.306	11.618	12.703	17.690	39.671	
9.899	8.647	8.610	9.356	10.470	10.657	13.127	18.101	41.265	
8.943	8.193	8.122	8.352	9.413	9.836	12.167	17.205	39.384	
7.576	7.290	7.080	7.368	8.219	8.791	10.880	15.966	37.684	
6.369	6.595	6.487	6.454	7.413	8.137	10.126	15.978	40.028	
4.740	4.805	4.871	5.079	5.919	7.121	9.659	17.634	49.549	
2.963	2.990	3.096	3.473	4.242	5.910	10.042	23.010	75.270	
1.096	1.208	1.396	1.827	2.772	5.295	12.651	37.673	131.867	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
9.794	10.701	11.074	9.868	10.441	11.415	12.911	17.135	38.000	
10.037	9.280	9.881	10.220	10.335	11.633	12.691	17.611	39.380	
9.931	8.692	8.653	9.390	10.488	10.644	13.048	17.338	40.346	
8.964	8.227	8.154	8.370	9.406	9.771	11.956	16.539	37.368	
7.590	7.304	7.095	7.363	8.164	8.615	10.366	14.567	33.103	
6.378	6.605	6.480	6.406	7.266	7.724	9.108	13.002	29.522	
4.744	4.801	4.830	4.959	5.583	6.326	7.529	11.003	25.129	
2.962	2.964	3.000	3.206	3.603	4.283	5.400	7.936	17.808	
1.089	1.152	1.200	1.352	1.539	1.918	2.606	3.921	7.952	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
9.827	10.738	11.107	9.891	10.458	11.428	12.918	17.149	37.956	
10.074	9.337	9.939	10.271	10.374	11.661	12.698	17.570	39.194	
9.963	8.749	8.720	9.449	10.534	10.673	13.040	17.739	39.970	
8.985	8.274	8.210	8.424	9.447	9.781	11.901	16.333	36.706	
7.604	7.336	7.134	7.400	8.178	8.592	10.256	14.255	32.081	
6.388	6.625	6.502	6.416	7.249	7.648	8.899	12.446	28.123	
4.748	4.807	4.830	4.931	5.514	6.165	7.153	10.230	23.255	
2.961	2.953	2.968	3.128	3.455	3.983	4.962	6.851	15.587	
1.082	1.118	1.125	1.203	1.273	1.479	1.846	2.627	5.591	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
9.873	10.781	11.140	9.915	10.477	11.442	12.925	17.143	37.912	
10.117	9.434	10.039	10.343	10.434	11.706	12.727	17.565	39.095	
9.995	8.846	8.846	9.559	10.636	10.755	13.098	17.749	39.850	
9.008	8.341	8.314	8.549	9.564	9.885	11.983	16.355	36.577	
7.620	7.386	7.224	7.508	8.297	8.704	10.344	14.277	31.972	
6.397	6.658	6.564	6.501	7.347	7.751	8.985	12.492	28.033	
4.753	4.825	4.867	4.998	5.583	6.241	7.238	10.269	23.186	
2.960	2.956	2.980	3.149	3.492	4.030	4.910	6.884	15.570	
1.075	1.106	1.115	1.199	1.286	1.509	1.899	2.713	5.735	
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX						
9.951	10.836	11.173	9.939	10.497	11.455	12.932	17.138	37.868	
10.172	9.716	10.238	10.491	10.535	11.783	12.783	17.597	39.068	
10.027	9.047	9.314	9.927	10.897	10.945	13.247	17.865	39.908	
9.030	8.482	8.681	9.242	10.119	10.299	12.301	16.630	36.814	
7.636	7.474	7.466	8.055	9.291	9.536	10.996	14.824	32.501	
6.407	6.716	6.720	6.875	8.162	8.247	10.324	13.622	29.146	
4.757	4.860	4.968	5.233	6.159	7.056	8.793	12.630	25.702	
2.959	2.973	3.044	3.320	3.900	5.044	7.506	12.645	22.941	
1.068	1.112	1.161	1.346	1.671	2.541	4.382	12.054	33.264	

TABLE 2.5 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY WITH $L = 1.2$
 WAVELENGTH = .80 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .361

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
9.654	10.307	10.519	9.295	9.732	10.503	11.673	15.179	35.962
9.694	8.832	9.325	9.577	9.608	10.701	11.513	15.703	37.611
9.482	8.232	8.146	9.790	9.759	9.838	11.940	16.177	39.306
9.522	7.774	7.673	7.852	8.792	9.125	11.168	15.614	37.702
7.201	6.899	6.693	6.944	7.719	8.244	10.200	14.908	36.497
6.047	6.249	6.143	6.117	7.033	7.799	9.340	15.751	39.717
4.507	4.573	4.651	4.888	5.780	7.127	10.103	19.014	51.064
2.841	2.888	3.036	3.503	4.446	6.570	11.906	27.829	80.834
1.116	1.264	1.545	2.144	3.568	7.074	17.230	49.367	143.875
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
9.716	10.370	10.580	9.333	9.757	10.519	11.679	15.167	35.912
9.756	8.940	9.403	9.577	9.644	10.714	11.488	15.592	37.195
9.542	8.308	8.209	9.835	9.775	9.810	11.920	15.826	39.311
9.558	7.825	7.715	7.871	8.772	9.021	10.864	14.734	35.515
7.223	6.931	6.708	6.928	7.628	7.991	9.469	13.057	31.493
6.060	6.260	6.126	6.040	6.810	7.190	8.392	11.758	28.113
4.513	4.563	4.586	4.704	5.278	5.959	7.057	10.133	24.073
2.839	2.848	2.891	3.102	3.492	4.172	5.243	7.530	17.114
1.106	1.130	1.252	1.436	1.679	2.115	2.878	4.177	7.739
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
9.787	10.446	10.641	9.371	9.782	10.536	11.685	15.156	35.862
9.832	9.047	9.502	9.711	9.698	10.746	11.487	15.529	37.088
9.603	8.406	8.317	9.920	9.834	9.839	11.795	15.683	37.898
9.594	7.900	7.797	7.944	8.820	9.020	10.772	14.451	34.794
7.245	6.979	6.761	6.973	7.635	7.932	9.299	12.610	30.032
6.073	6.287	6.152	6.044	6.771	7.067	8.085	11.046	26.115
4.518	4.567	4.579	4.654	5.137	5.715	6.527	9.109	22.142
2.837	2.828	2.837	2.981	3.270	3.731	4.481	5.152	14.709
1.096	1.131	1.142	1.218	1.591	1.485	1.820	2.493	5.107
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
9.883	10.538	10.701	9.410	9.810	10.553	11.690	15.144	35.812
9.925	9.243	9.687	9.829	9.787	10.805	11.517	15.311	36.872
9.682	8.539	8.544	9.100	9.998	9.948	11.859	15.676	37.752
8.631	8.012	7.971	8.143	8.993	9.160	10.864	14.451	34.630
7.269	7.057	6.902	7.137	7.805	8.080	9.399	12.633	30.234
6.086	6.334	6.244	6.167	6.910	7.202	8.133	11.076	26.117
4.523	4.591	4.629	4.731	5.257	5.811	6.618	9.136	22.145
2.833	2.830	2.852	3.005	3.317	3.791	4.539	5.136	14.705
1.095	1.113	1.129	1.215	1.516	1.541	1.914	2.651	5.187
AZIMUTH = 150.00 DEGREES			TOTAL RADIANCE MATRIX					
10.038	10.660	10.763	9.450	9.838	10.570	11.694	15.133	35.712
10.048	9.837	10.105	10.102	9.951	10.915	11.586	15.537	36.829
9.723	9.010	9.509	9.837	10.451	10.245	12.061	15.805	37.787
8.668	8.280	8.711	9.539	10.067	9.873	11.344	14.303	34.355
7.293	7.207	7.349	8.213	9.770	9.653	10.492	13.416	30.211
6.099	6.424	6.507	6.349	6.490	10.112	10.653	12.837	27.122
4.528	4.642	4.769	5.152	5.712	6.343	7.151	10.693	25.642
2.833	2.853	2.950	3.223	4.036	5.671	7.480	10.154	21.117
1.075	1.124	1.204	1.465	2.000	3.417	7.421	19.422	47.345

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TABLE B.2.6BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY WITH LAI = 1.2
 WAVELENGTH = .80 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .689

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
9.945	9.854	9.651	8.346	8.548	9.044	9.894	12.999	35.673	
9.332	8.198	8.425	8.498	8.398	9.206	9.787	13.515	37.461	
8.795	7.498	7.303	7.773	8.520	8.497	10.215	14.053	39.366	
7.773	7.006	6.848	6.949	7.708	7.956	9.707	13.835	37.773	
6.515	6.193	5.979	6.176	6.840	7.336	9.185	13.679	36.615	
5.450	5.604	5.505	5.503	6.360	7.221	9.372	15.375	40.170	
4.079	4.139	4.241	4.535	5.519	7.095	10.642	20.288	52.298	
2.622	2.702	2.924	3.545	4.767	7.565	14.388	32.624	83.749	
1.175	1.379	1.814	2.690	4.711	9.780	23.379	51.359	153.614	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
10.124	10.020	9.799	8.427	8.594	9.071	9.901	12.993	35.521	
9.498	8.462	8.593	8.602	8.458	9.222	9.748	13.375	37.138	
8.944	7.665	7.425	7.847	8.541	8.450	10.042	13.616	38.346	
7.853	7.108	6.921	6.975	7.672	7.794	9.277	12.740	35.525	
6.560	6.251	6.001	6.145	6.695	6.940	8.158	11.372	31.440	
5.475	5.623	5.476	5.377	6.013	6.311	7.338	10.412	23.157	
4.088	4.123	4.136	4.243	4.742	5.349	6.347	9.116	24.113	
2.620	2.637	2.694	2.914	3.295	3.975	4.978	7.108	17.002	
1.161	1.251	1.360	1.595	1.918	2.424	3.242	4.402	7.487	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
10.324	10.226	9.948	8.508	8.641	9.097	9.908	12.967	35.569	
9.705	8.725	8.814	8.759	8.553	9.270	9.743	13.292	36.925	
9.093	7.886	7.652	8.008	8.638	8.490	10.001	13.434	37.922	
7.933	7.262	7.079	7.106	7.748	7.788	9.142	12.384	34.786	
6.604	6.342	6.095	6.221	6.702	6.363	7.915	10.815	30.303	
5.500	5.671	5.519	5.383	5.951	6.124	6.906	9.491	26.205	
4.097	4.133	4.126	4.165	4.570	4.986	5.608	7.852	22.034	
2.613	2.609	2.614	2.728	2.958	3.327	3.927	5.350	14.542	
1.148	1.179	1.197	1.271	1.347	1.522	1.806	2.348	4.875	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
10.586	10.487	10.095	8.591	8.691	9.123	9.915	12.952	35.517	
9.968	9.249	9.265	9.010	8.720	9.367	9.782	13.266	36.304	
9.242	8.339	8.189	8.388	8.936	8.676	10.092	13.420	37.769	
8.015	7.510	7.456	7.518	8.076	8.030	9.279	12.382	34.617	
6.652	6.503	6.387	6.545	7.018	7.122	8.071	10.850	30.158	
5.525	5.763	5.700	5.622	6.210	6.361	7.070	9.552	26.483	
4.107	4.177	4.223	4.311	4.741	5.167	5.780	7.934	21.131	
2.616	2.617	2.649	2.786	3.065	3.469	4.078	5.483	14.525	
1.134	1.162	1.199	1.304	1.449	1.699	2.071	2.744	5.451	
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX						
10.976	10.845	10.244	8.675	8.742	9.150	9.922	12.936	35.465	
10.328	10.884	10.418	9.668	9.061	9.562	9.887	13.295	36.757	
9.391	9.506	10.790	10.322	10.001	9.266	10.433	13.598	37.307	
8.098	8.175	9.422	11.176	10.784	9.602	10.184	12.923	34.869	
6.700	6.841	7.468	9.313	12.026	10.935	10.372	12.212	30.743	
5.549	5.949	6.297	7.244	10.176	13.549	12.798	13.105	28.606	
4.116	4.278	4.560	5.285	7.223	11.343	17.311	17.607	28.178	
2.614	2.636	2.653	3.401	4.696	7.344	15.543	29.036	34.313	
1.120	1.197	1.368	1.852	2.952	5.853	13.958	36.350	74.746	

TABLE 3.1 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=4.0.
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .259

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
3.391	3.070	2.968	2.843	3.067	3.285	3.946	5.395	10.797	
3.032	2.833	2.658	2.685	2.896	3.284	4.042	5.711	11.773	
2.773	2.514	2.349	2.403	2.602	2.988	3.782	5.508	11.620	
2.333	2.130	2.102	2.244	2.468	2.959	3.880	6.042	13.048	
1.997	1.790	1.820	1.955	2.221	2.766	3.935	6.558	15.317	
1.568	1.554	1.634	1.784	2.123	2.876	4.389	8.364	21.751	
1.205	1.222	1.322	1.559	2.060	3.058	5.516	12.576	37.595	
.923	.982	1.145	1.511	2.223	3.911	8.423	22.917	77.350	
.673	.786	1.064	1.584	2.802	5.886	14.972	46.367	164.091	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
3.463	3.140	3.036	2.890	3.104	3.316	3.968	5.400	10.753	
3.102	2.952	2.753	2.764	2.962	3.329	4.051	5.629	11.429	
2.839	2.606	2.439	2.482	2.657	3.000	3.699	5.130	10.495	
2.376	2.202	2.176	2.300	2.489	2.897	3.617	5.179	10.621	
2.026	1.843	1.866	1.975	2.171	2.548	3.257	4.764	9.866	
1.589	1.586	1.645	1.740	1.940	2.327	3.058	4.594	9.316	
1.217	1.230	1.280	1.408	1.613	2.012	2.767	4.242	8.499	
.927	.956	1.024	1.156	1.381	1.802	2.501	3.930	7.326	
.667	.716	.806	.967	1.227	1.618	2.310	3.513	6.039	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
3.546	3.224	3.104	2.936	3.140	3.347	3.989	5.404	10.710	
3.186	3.072	2.871	2.869	3.048	3.398	4.091	5.604	11.227	
2.906	2.721	2.575	2.606	2.764	3.084	3.733	5.092	10.066	
2.419	2.298	2.293	2.421	2.594	2.960	3.591	4.954	9.845	
2.056	1.914	1.956	2.070	2.236	2.566	3.159	4.373	8.644	
1.611	1.635	1.707	1.791	1.959	2.269	2.822	3.905	7.635	
1.230	1.255	1.305	1.399	1.553	1.830	2.506	3.266	6.253	
.931	.953	.999	1.071	1.205	1.424	1.813	2.559	4.668	
.661	.679	.718	.784	.890	1.058	1.347	1.897	3.226	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
3.664	3.329	3.172	2.985	3.180	3.377	4.010	5.408	10.667	
3.290	3.290	3.078	3.014	3.173	3.499	4.168	5.638	11.145	
2.972	2.924	2.834	2.829	2.976	3.263	3.880	5.179	9.995	
2.463	2.432	2.505	2.676	2.841	3.192	3.797	5.083	9.798	
2.089	2.018	2.142	2.297	2.492	2.821	3.392	4.560	8.665	
1.632	1.709	1.844	1.980	2.185	2.518	3.066	4.122	7.719	
1.242	1.301	1.398	1.539	1.729	2.039	2.549	3.490	6.402	
.935	.974	1.048	1.150	1.329	1.589	2.012	2.790	4.923	
.656	.676	.731	.821	.974	1.196	1.557	2.232	3.339	
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX						
3.866	3.467	3.241	3.034	3.221	3.408	4.032	5.412	10.624	
3.430	4.007	3.548	3.320	3.375	3.659	4.297	5.733	11.168	
3.040	3.396	3.971	3.657	3.510	3.648	4.193	5.445	10.195	
2.508	2.727	3.330	4.310	4.063	4.037	4.442	5.660	10.331	
2.122	2.195	2.642	3.504	4.800	4.635	4.720	5.661	9.731	
1.653	1.828	2.159	2.749	3.966	5.962	5.959	6.398	9.355	
1.255	1.380	1.609	2.039	2.913	4.890	6.388	8.927	11.363	
.939	1.021	1.191	1.506	2.153	3.650	7.545	15.647	19.665	
.650	.704	.840	1.124	1.725	3.159	7.264	20.774	59.266	

TABLE B.3.2 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=4.0.
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .429

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
4.132	3.400	3.076	2.842	2.973	3.118	3.655	4.846	9.910
3.366	2.949	2.673	2.633	2.787	3.113	3.764	5.190	10.893
2.899	2.542	2.328	2.347	2.518	2.869	3.598	5.156	10.881
2.379	2.129	2.075	2.198	2.413	2.894	3.807	5.914	12.449
2.010	1.789	1.811	1.948	2.234	2.827	4.117	6.851	15.132
1.587	1.567	1.653	1.832	2.235	3.145	4.943	9.499	22.483
1.248	1.273	1.403	1.706	2.368	3.667	6.870	15.539	40.555
.999	1.086	1.312	1.828	2.817	5.196	11.440	30.029	85.887
.805	.969	1.371	2.122	3.908	8.419	21.336	62.499	186.203
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
4.287	3.538	3.201	2.917	3.024	3.154	3.675	4.841	9.857
3.504	3.169	2.826	2.744	2.868	3.154	3.754	5.066	10.321
3.022	2.693	2.457	2.444	2.571	2.860	3.461	4.721	9.675
2.450	2.233	2.168	2.256	2.417	2.780	3.422	4.784	9.841
2.054	1.859	1.859	1.954	2.136	2.492	3.152	4.502	9.191
1.615	1.602	1.652	1.748	1.949	2.332	3.053	4.497	8.738
1.262	1.274	1.329	1.469	1.694	2.123	2.917	4.335	8.056
1.002	1.040	1.125	1.288	1.551	2.053	2.825	4.263	7.032
.796	.862	.982	1.195	1.532	2.018	2.834	4.059	5.936
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
4.464	3.708	3.326	2.992	3.074	3.190	3.694	4.837	9.805
3.674	3.390	3.024	2.901	2.979	3.233	3.783	5.010	10.291
3.146	2.887	2.670	2.618	2.701	2.944	3.470	4.574	9.202
2.522	2.381	2.334	2.413	2.536	2.829	3.345	4.459	8.996
2.098	1.957	1.975	2.066	2.194	2.477	2.974	3.966	7.871
1.644	1.664	1.722	1.794	1.942	2.212	2.689	3.577	6.928
1.276	1.300	1.347	1.433	1.579	1.832	2.248	3.049	5.640
1.005	1.028	1.074	1.147	1.278	1.489	1.847	2.472	4.176
.796	.806	.849	.921	1.035	1.209	1.491	1.969	2.909
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
4.709	3.925	3.451	3.069	3.130	3.227	3.714	4.833	9.752
3.892	3.824	3.404	3.133	3.156	3.357	3.861	5.023	10.180
3.269	3.265	3.130	2.971	3.008	3.172	3.626	4.629	9.081
2.595	2.603	2.678	2.807	2.883	3.124	3.568	4.552	8.882
2.146	2.114	2.257	2.396	2.543	2.798	3.227	4.120	7.812
1.672	1.764	1.914	2.054	2.241	2.518	2.954	3.767	6.928
1.291	1.358	1.466	1.611	1.798	2.082	2.518	3.256	5.713
1.008	1.050	1.131	1.239	1.427	1.687	2.076	2.712	4.395
.777	.799	.865	.971	1.152	1.404	1.782	2.416	3.631
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX					
5.114	4.223	3.577	3.147	3.185	3.263	3.734	4.829	9.699
4.192	5.318	4.367	3.692	3.476	3.574	4.009	5.105	10.170
3.395	4.235	5.453	4.602	3.942	3.753	4.029	4.910	9.222
2.669	3.155	4.318	4.068	5.212	4.549	4.502	5.242	9.355
2.195	2.411	3.167	4.737	7.057	6.160	5.390	5.615	8.908
1.701	1.944	2.436	3.432	5.637	9.126	8.174	7.296	9.471
1.305	1.466	1.788	2.443	3.918	7.456	13.459	12.614	12.471
1.011	1.110	1.337	1.800	2.831	5.405	12.322	25.570	26.246
.767	.839	1.026	1.455	2.413	4.855	11.970	34.491	35.293

TABLE 3.3 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=4.0.
WAVELENGTH = .68 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
OPTICAL DEPTH = .809

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
6.317	4.356	3.426	2.914	2.856	2.879	3.266	4.251	9.200	
4.334	3.312	2.769	2.578	2.626	2.858	3.382	4.614	10.174	
3.286	2.663	2.326	2.269	2.382	2.683	3.330	4.730	10.233	
2.539	2.164	2.045	2.127	2.321	2.783	3.670	5.677	11.857	
2.073	1.807	1.905	1.937	2.245	2.890	4.298	6.982	14.753	
1.644	1.601	1.687	1.906	2.395	3.499	5.562	10.364	22.589	
1.338	1.367	1.538	1.937	2.225	4.495	8.452	18.017	41.895	
1.143	1.267	1.588	2.376	3.703	6.961	15.016	36.197	90.444	
1.046	1.283	1.874	2.968	5.553	11.907	29.004	77.309	200.066	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
6.722	4.689	3.707	3.062	2.941	2.930	3.286	4.241	9.143	
4.669	3.814	3.077	2.769	2.743	2.906	3.355	4.457	9.795	
3.570	2.969	2.551	2.414	2.448	2.651	3.132	4.206	8.999	
2.686	2.350	2.187	2.199	2.308	2.601	3.115	4.325	9.181	
2.155	1.918	1.866	1.930	2.083	2.400	2.986	4.164	8.570	
1.691	1.649	1.675	1.765	1.960	2.326	3.008	4.307	8.190	
1.360	1.364	1.417	1.571	1.814	2.267	3.065	4.320	7.588	
1.149	1.194	1.298	1.503	1.810	2.396	3.190	4.477	6.872	
1.034	1.124	1.284	1.568	2.000	2.582	3.469	4.526	5.760	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
7.181	5.110	3.989	3.209	3.025	2.991	3.307	4.231	9.087	
5.092	4.315	3.486	3.057	2.921	3.007	3.379	4.378	9.553	
3.854	3.379	2.967	2.710	2.637	2.753	3.123	4.014	8.510	
2.833	2.634	2.479	2.469	2.472	2.646	3.018	3.922	8.313	
2.237	2.089	2.049	2.092	2.148	2.355	2.725	3.514	7.238	
1.739	1.746	1.776	1.821	1.932	2.134	2.506	3.204	6.239	
1.382	1.401	1.439	1.507	1.633	1.842	2.164	2.788	5.117	
1.154	1.176	1.220	1.289	1.405	1.594	1.889	2.349	3.751	
1.022	1.044	1.092	1.170	1.237	1.455	1.700	2.046	2.654	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
7.778	5.663	4.270	3.361	3.117	3.031	3.328	4.221	9.030	
5.649	3.374	4.344	3.513	3.224	3.190	3.471	4.379	9.430	
4.137	4.242	3.975	3.400	3.179	3.101	3.317	4.057	8.369	
2.984	3.088	3.168	3.200	3.073	3.101	3.304	4.005	8.176	
2.324	2.533	2.585	2.687	2.731	2.849	3.059	3.678	7.159	
1.786	1.920	2.113	2.268	2.425	2.601	2.871	3.432	6.332	
1.404	1.494	1.634	1.799	1.983	2.228	2.558	3.070	5.215	
1.159	1.214	1.315	1.442	1.657	1.926	2.266	2.731	4.068	
1.009	1.043	1.140	1.285	1.528	1.834	2.238	2.605	3.263	
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX						
8.763	6.447	4.554	3.513	3.209	3.082	3.348	4.211	9.273	
6.439	9.143	6.755	4.760	3.842	3.542	3.668	4.460	9.407	
4.423	6.684	9.712	7.313	5.164	4.158	3.927	4.344	8.492	
3.134	4.354	7.153	11.046	8.444	5.991	4.907	4.955	8.677	
2.412	3.001	4.614	9.208	13.283	10.293	7.222	6.032	8.492	
1.833	2.259	3.182	5.286	10.212	17.514	13.837	9.634	7.337	
1.426	1.684	2.246	3.500	6.560	14.148	25.768	21.006	15.477	
1.164	1.314	1.673	2.535	4.538	9.776	23.730	46.731	38.611	
.997	1.124	1.442	2.208	4.014	8.678	22.010	60.507	125.467	

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TABLE B.3.4 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=4.0.
WAVELENGTH = .80 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
OPTICAL DEPTH = .222

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
10.401	10.353	10.820	11.309	12.294	13.882	17.186	24.174	54.278	
10.283	10.450	10.628	11.211	12.269	14.229	17.903	25.353	57.772	
9.379	9.538	9.553	10.120	11.167	12.747	15.907	22.689	51.607	
8.579	8.427	8.612	9.450	10.419	12.140	15.381	22.320	51.507	
7.442	7.079	7.368	7.873	8.738	10.308	13.339	19.863	47.001	
5.954	5.946	6.254	6.649	7.448	9.005	11.933	18.816	46.820	
4.070	4.150	4.376	4.873	5.588	7.084	10.324	18.769	52.539	
2.525	2.647	2.817	3.227	4.000	5.710	10.014	23.186	75.692	
.946	1.032	1.262	1.715	2.721	5.269	12.671	37.759	132.096	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
10.429	10.384	10.853	11.332	12.312	13.895	17.193	24.169	54.235	
10.315	10.508	10.675	11.248	12.298	14.244	17.791	25.274	57.481	
9.411	9.583	9.596	10.155	11.185	12.734	15.827	22.426	50.688	
8.600	8.461	8.644	9.468	10.413	12.074	15.170	21.655	49.490	
7.456	7.103	7.383	7.868	8.683	10.132	12.825	18.464	42.420	
5.963	5.957	6.247	6.601	7.301	8.591	10.915	15.840	36.313	
4.074	4.146	4.336	4.753	5.253	6.299	8.193	12.137	28.119	
2.524	2.622	2.722	2.961	3.361	4.084	5.372	9.112	18.231	
.939	.975	1.066	1.239	1.488	1.892	2.627	4.007	8.181	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
10.462	10.421	10.886	11.355	12.329	13.909	17.200	24.163	54.191	
10.352	10.565	10.733	11.300	12.337	14.272	17.797	25.233	57.295	
9.443	9.640	9.663	10.213	11.231	12.763	15.820	22.327	50.312	
8.621	8.508	8.700	9.522	10.453	12.085	15.115	21.449	48.829	
7.470	7.135	7.422	7.905	8.697	10.109	12.715	18.132	41.398	
5.972	5.977	6.269	6.611	7.283	8.516	10.705	15.293	34.914	
4.079	4.152	4.335	4.724	5.184	6.127	7.823	11.364	26.245	
2.523	2.610	2.689	2.982	3.214	3.793	4.834	7.027	16.009	
.933	.942	.991	1.090	1.222	1.453	1.867	2.713	5.820	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
10.508	10.464	10.919	11.380	12.348	13.922	17.207	24.157	54.147	
10.395	10.662	10.833	11.372	12.398	14.317	17.826	25.228	57.196	
9.475	9.738	9.789	10.323	11.334	12.845	15.877	22.337	50.192	
8.643	8.574	8.804	9.647	10.570	12.189	15.197	21.470	48.699	
7.486	7.186	7.512	8.012	8.816	10.220	12.803	18.174	41.289	
5.982	6.010	6.332	6.696	7.382	8.619	10.722	15.330	34.824	
4.083	4.170	4.373	4.781	5.253	6.204	7.902	11.403	26.178	
2.523	2.613	2.701	2.903	3.251	3.831	4.882	7.060	15.992	
.926	.929	.981	1.086	1.235	1.483	1.919	2.804	6.014	
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX									
10.586	10.519	10.952	11.404	12.368	13.935	17.214	24.151	54.103	
10.450	10.943	11.032	11.519	12.498	14.394	17.883	25.260	57.169	
9.508	9.938	10.256	10.692	11.594	13.035	16.026	22.452	50.250	
8.665	8.716	9.171	10.340	11.125	12.603	15.515	21.746	48.936	
7.502	7.273	7.754	8.559	9.810	11.052	13.455	18.721	41.818	
5.991	6.067	6.487	7.070	8.197	10.114	12.131	16.460	35.939	
4.087	4.205	4.473	5.026	5.829	7.319	10.459	13.964	28.772	
2.522	2.630	2.765	3.075	3.658	4.845	7.478	12.820	23.363	
.919	.936	1.027	1.233	1.620	2.515	4.903	12.140	33.514	

TABLE B.3.5 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=4.0.
WAVELENGTH = .80 MICROMETERS, VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
OPTICAL DEPTH = .341

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX								
10.253	10.009	10.312	10.662	11.465	12.773	15.526	21.380	51.894
9.955	9.988	10.071	10.537	11.426	13.093	16.104	22.487	55.464
8.992	9.071	9.030	9.504	10.405	11.750	14.442	20.236	49.499
8.179	7.994	8.132	8.876	9.724	11.232	14.060	20.142	49.681
7.075	6.711	6.962	7.415	8.199	9.629	12.409	18.352	45.687
5.657	5.641	5.925	6.298	7.065	8.590	11.461	18.256	46.430
3.881	3.961	4.190	4.697	5.476	7.093	10.697	20.013	54.022
2.436	2.571	2.779	3.278	4.226	6.391	11.880	27.982	81.249
.983	1.107	1.425	2.044	3.463	7.052	17.248	49.439	146.091
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX								
10.315	10.072	10.373	10.700	11.490	12.790	15.532	21.368	51.844
10.018	10.095	10.148	10.592	11.463	13.106	16.079	22.376	55.148
9.052	9.147	9.093	9.548	10.421	11.722	14.321	19.885	48.504
8.214	8.045	8.174	8.824	9.704	11.127	13.755	19.261	47.494
7.096	6.743	6.978	7.398	8.108	9.366	11.678	16.501	40.683
5.670	5.652	5.908	6.221	6.842	7.981	10.013	14.293	34.875
3.887	3.951	4.125	4.513	4.975	5.926	7.651	11.131	27.031
2.433	2.530	2.634	2.877	3.272	3.993	5.217	7.734	17.529
.973	1.023	1.133	1.337	1.634	2.093	2.895	4.250	7.956
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX								
10.385	10.147	10.434	10.738	11.515	12.807	15.538	21.357	51.794
10.094	10.202	10.247	10.671	11.517	13.138	16.078	22.312	54.942
9.113	9.245	9.201	9.634	10.480	11.751	14.297	19.743	48.091
8.250	8.119	8.256	8.968	9.752	11.127	13.664	18.978	46.772
7.118	6.790	7.030	7.443	8.115	9.313	11.503	16.053	39.572
5.683	5.679	5.934	6.225	6.804	7.859	9.706	13.551	33.357
3.892	3.956	4.118	4.463	4.863	5.681	7.120	10.108	25.000
2.431	2.511	2.582	2.755	3.050	3.551	4.456	6.305	15.124
.963	.974	1.022	1.118	1.246	1.463	1.838	2.565	5.403
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX								
10.481	10.239	10.494	10.778	11.543	12.823	15.544	21.345	51.744
10.186	10.399	10.432	10.789	11.606	13.196	16.107	22.294	54.826
9.172	9.428	9.428	9.813	10.634	11.961	14.360	19.735	47.945
8.287	8.232	8.430	9.167	9.924	11.267	13.756	18.978	46.808
7.142	6.869	7.172	7.607	8.285	9.466	11.608	16.076	39.424
5.696	5.726	6.026	6.348	6.942	7.993	9.804	13.581	33.229
3.897	3.979	4.169	4.540	4.954	5.778	7.212	10.134	24.903
2.429	2.512	2.595	2.780	3.097	3.612	4.514	6.339	15.105
.953	.956	1.009	1.115	1.271	1.519	1.931	2.723	5.703
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX								
10.636	10.361	10.556	10.818	11.571	12.840	15.550	21.334	51.694
10.309	10.992	10.850	11.062	11.769	13.306	16.177	22.321	54.783
9.233	9.849	10.393	10.550	11.097	12.158	14.563	19.864	47.980
8.325	8.499	9.170	10.563	10.999	11.980	14.236	19.330	46.834
7.167	7.019	7.619	8.683	10.250	11.038	12.701	16.859	40.009
5.709	5.816	6.290	7.030	8.523	10.904	12.280	15.402	34.635
3.902	4.031	4.329	4.961	6.009	6.309	12.105	14.692	28.600
2.427	2.536	2.693	3.063	3.816	5.491	9.455	16.908	26.522
.943	.967	1.085	1.366	1.955	3.405	7.439	19.495	48.111

TABLE B.3.6 BRDF-ATMOSPHERE ANALYSIS FOR A SPHERICAL GRASS CANOPY LAI=4.0.
 WAVELENGTH = .90 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .689

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX								
10.474	9.591	9.469	9.536	10.041	10.974	13.138	18.370	53.005
9.563	9.217	9.079	9.334	9.964	11.241	13.653	19.408	57.134
8.362	8.236	8.077	8.393	9.076	10.121	12.322	17.575	50.576
7.470	7.199	7.249	7.838	8.509	9.744	12.140	17.765	51.037
6.404	6.028	6.214	6.582	7.251	8.507	11.037	16.657	46.749
5.109	5.073	5.316	5.659	6.388	7.988	10.726	17.537	47.612
3.535	3.610	3.845	4.372	5.262	7.067	11.135	21.145	55.579
2.277	2.432	2.707	3.356	4.585	7.418	14.368	32.753	84.205
1.070	1.256	1.721	2.613	4.677	9.763	23.392	61.415	153.833
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX								
10.653	9.756	9.617	9.617	10.087	11.001	13.145	18.354	52.953
9.730	9.481	9.246	9.438	10.024	11.256	13.616	19.268	56.811
8.511	8.403	8.199	8.468	9.097	10.074	12.148	17.138	49.555
7.550	7.301	7.322	7.864	8.473	9.581	11.710	16.670	48.789
6.449	6.085	6.236	6.552	7.106	8.112	10.011	14.350	41.574
5.134	5.092	5.287	5.533	6.040	6.978	8.692	12.574	35.600
3.545	3.594	3.739	4.080	4.485	5.320	6.839	9.973	27.404
2.275	2.368	2.477	2.726	3.112	3.828	4.958	7.237	17.458
1.057	1.128	1.267	1.518	1.884	2.407	3.255	4.458	7.706
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX								
10.853	9.963	9.766	9.698	10.133	11.027	13.152	18.338	52.901
9.937	9.744	9.468	9.596	10.120	11.305	13.611	19.185	56.598
8.660	8.625	8.426	8.628	9.194	10.114	12.107	16.956	49.132
7.629	7.455	7.481	7.995	8.549	9.575	11.575	16.314	48.050
6.493	6.177	6.330	6.628	7.113	8.034	9.767	13.793	40.436
5.158	5.140	5.330	5.539	5.979	6.791	8.261	11.654	34.047
3.554	3.603	3.729	4.002	4.313	4.958	6.100	8.709	25.325
2.273	2.340	2.397	2.539	2.775	3.180	3.907	5.479	14.997
1.043	1.056	1.104	1.194	1.313	1.505	1.819	2.404	5.094
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX								
11.115	10.223	9.913	9.781	10.184	11.053	13.159	18.323	52.849
10.199	10.268	9.919	9.846	10.286	11.401	13.651	19.159	56.477
8.808	9.077	8.963	9.008	9.492	10.300	12.199	16.942	48.979
7.712	7.703	7.858	8.407	8.877	9.817	11.712	16.312	47.881
6.541	6.337	6.622	6.952	7.429	8.293	9.923	13.828	40.291
5.183	5.232	5.511	5.778	6.238	7.028	8.425	11.715	33.936
3.563	3.648	3.827	4.148	4.495	5.139	6.273	8.790	25.372
2.271	2.348	2.432	2.598	2.883	3.322	4.058	5.612	15.080
1.029	1.038	1.106	1.227	1.415	1.682	2.084	2.801	5.670
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX								
11.505	10.581	10.062	9.865	10.235	11.080	13.166	18.307	52.797
10.560	11.903	11.072	10.504	10.628	11.597	13.755	19.139	56.430
8.958	10.244	11.565	10.943	10.557	10.890	12.539	17.120	49.017
7.795	8.368	9.824	12.065	11.585	11.389	12.618	16.953	48.154
6.589	6.675	7.703	9.725	12.436	12.106	12.224	15.190	41.077
5.208	5.418	6.098	7.400	10.203	14.216	14.152	15.267	36.048
3.573	3.749	4.164	5.092	6.976	11.315	17.303	18.464	31.370
2.269	2.397	2.636	3.212	4.513	7.697	15.523	28.212	34.839
1.016	1.074	1.275	1.775	2.918	5.836	13.951	36.396	74.264

TABLE B.4.1BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=.50.
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 M
 OPTICAL DEPTH = .259

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX								
6.608	5.765	6.267	6.138	5.129	5.497	5.142	5.335	3.981
6.072	5.368	5.929	5.839	4.893	5.286	5.002	5.329	4.394
5.513	4.923	5.481	5.426	4.574	4.994	4.835	5.398	5.310
4.896	4.395	4.923	4.873	4.182	4.617	4.689	5.720	6.827
4.086	4.090	4.267	3.940	3.613	4.266	4.797	6.366	10.270
3.333	3.358	3.534	3.336	3.198	4.020	5.004	8.125	17.473
2.561	2.686	2.426	2.571	3.282	3.899	6.115	12.366	34.323
1.700	1.494	1.765	2.095	2.777	4.333	8.528	22.743	75.667
.779	.894	1.166	1.673	2.874	5.936	14.979	46.295	163.762
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX								
6.679	5.835	6.335	6.184	5.165	5.528	5.163	5.339	3.938
6.142	5.487	6.024	5.918	4.959	5.332	5.011	5.246	4.051
5.579	5.015	5.571	5.504	4.629	5.006	4.753	5.070	4.185
4.939	4.466	4.996	4.929	4.204	4.555	4.426	4.856	4.400
4.116	4.144	4.313	3.960	3.562	4.047	4.119	4.572	4.819
3.355	3.390	3.545	3.292	3.015	3.470	3.674	4.355	5.037
2.574	2.694	2.385	2.420	2.835	2.853	3.365	4.032	5.237
1.704	1.468	1.644	1.740	1.935	2.226	2.607	3.756	5.642
.773	.824	.908	1.055	1.298	1.668	2.317	3.441	5.709
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX								
6.763	5.919	6.403	6.231	5.202	5.558	5.184	5.343	3.895
6.226	5.607	6.142	6.023	5.045	5.401	5.050	5.222	3.848
5.646	5.130	5.707	5.629	4.735	5.090	4.786	4.982	3.757
4.982	4.563	5.114	5.050	4.309	4.618	4.400	4.632	3.624
4.145	4.214	4.40	4.056	3.628	4.066	4.021	4.182	3.597
3.376	3.439	3.607	3.343	3.034	3.412	3.438	3.666	3.357
2.586	2.719	2.409	2.411	2.775	2.671	2.965	3.056	2.990
1.708	1.465	1.618	1.656	1.760	1.948	1.919	2.336	2.984
.767	.798	.820	.872	.962	1.109	1.354	1.925	2.995
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX								
6.880	6.023	6.471	6.290	5.242	5.589	5.206	5.348	3.851
6.330	5.826	6.348	6.169	5.170	5.502	5.128	5.256	3.766
5.712	5.333	5.966	5.852	4.947	5.269	4.933	5.068	3.685
5.027	4.697	5.326	5.304	4.555	4.851	4.606	4.761	3.577
4.178	4.319	4.590	4.292	3.383	4.321	4.254	4.369	3.519
3.398	3.512	3.744	3.532	3.260	3.661	3.682	3.883	3.441
2.599	2.765	2.502	2.551	2.951	2.880	3.147	3.281	3.139
1.711	1.486	1.667	1.734	1.883	2.012	2.118	2.616	3.240
.762	.784	.834	.909	1.046	1.247	1.564	2.160	3.509
AZIMUTH = 159.00 DEGREES TOTAL RADIANCE MATRIX								
7.082	6.162	6.540	6.329	5.282	5.620	5.227	5.352	3.808
6.470	6.542	6.819	6.475	5.372	5.561	5.256	5.351	3.790
5.780	5.805	7.103	6.680	5.482	5.654	5.246	5.335	3.665
5.071	4.992	6.151	6.939	5.777	5.696	5.252	5.338	4.109
4.211	4.496	5.090	5.490	6.192	6.134	5.582	5.470	4.685
3.419	3.632	4.060	4.300	5.042	7.105	6.574	6.159	5.577
2.611	2.844	2.713	3.051	4.135	5.731	8.997	8.716	9.101
1.715	1.533	1.811	2.090	2.708	4.073	7.651	15.473	17.952
.755	.813	.942	1.213	1.796	3.209	7.221	20.792	58.975

TABLE B.4.2BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=.50.
WAVELENGTH = .68 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
OPTICAL DEPTH = .429

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
7.110	5.890	6.114	5.857	4.841	5.094	4.702	4.794	3.531
6.180	5.291	5.683	5.518	4.596	4.901	4.604	4.862	3.986
5.433	4.766	5.210	5.111	4.302	4.660	4.519	5.062	4.981
4.748	4.218	4.668	4.599	3.963	4.374	4.514	5.637	6.633
3.938	3.908	4.058	3.759	3.491	4.162	4.869	6.687	10.422
3.212	3.225	3.393	3.243	3.204	4.161	5.479	9.295	18.499
2.490	2.612	2.408	2.622	3.464	4.411	7.389	15.361	37.532
1.704	1.549	1.871	2.351	3.309	5.567	11.531	29.882	84.342
.897	1.063	1.460	2.198	3.969	8.461	21.341	62.441	185.912
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
7.264	6.028	6.239	5.931	4.891	5.130	4.721	4.789	3.479
6.318	5.511	5.837	5.629	4.676	4.945	4.594	4.758	3.614
5.557	4.917	5.338	5.298	4.356	4.650	4.382	4.626	3.774
4.820	4.322	4.760	4.657	3.967	4.259	4.130	4.507	4.025
3.982	3.478	4.105	3.765	3.393	3.827	3.905	4.338	4.481
3.241	3.260	3.391	3.159	2.918	3.348	3.589	4.293	4.754
2.505	2.613	2.335	2.385	2.790	2.867	3.436	4.156	5.032
1.707	1.503	1.683	1.811	2.044	2.424	2.915	4.116	5.487
.888	.956	1.070	1.271	1.593	2.060	2.840	4.000	5.645
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
7.441	6.198	6.364	6.006	4.942	5.166	4.741	4.785	3.426
6.488	5.732	6.035	5.786	4.788	5.021	4.623	4.682	3.384
5.681	5.111	5.552	5.382	4.485	4.735	4.392	4.479	3.301
4.891	4.470	4.927	4.814	4.086	4.308	4.053	4.183	3.181
4.026	4.076	4.221	3.876	3.451	3.812	3.727	3.802	3.161
3.269	3.321	3.462	3.205	2.911	3.227	3.225	3.375	2.944
2.509	2.639	2.353	2.349	2.675	2.576	2.767	2.871	2.816
1.710	1.491	1.633	1.671	1.770	1.860	1.938	2.326	2.631
.878	.900	.938	.997	1.096	1.252	1.496	1.911	2.516
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
7.686	6.415	6.488	6.084	4.997	5.203	4.761	4.781	3.374
6.706	6.166	6.414	6.019	4.965	5.146	4.702	4.695	3.273
5.804	5.489	6.012	5.735	4.793	4.963	4.547	4.535	3.180
4.964	4.692	5.270	5.207	4.434	4.604	4.275	4.275	3.067
4.074	4.233	4.503	4.206	3.800	4.133	3.979	3.956	3.102
3.297	3.421	3.653	3.465	3.210	3.533	3.490	3.563	2.943
2.534	2.697	2.471	2.527	2.894	2.826	3.037	3.078	2.689
1.713	1.514	1.690	1.762	1.919	2.058	2.167	2.566	2.950
.869	.893	.953	1.047	1.214	1.446	1.798	2.358	3.340
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX					
8.092	6.713	6.614	6.162	5.053	5.239	4.780	4.777	3.221
7.006	7.660	7.377	6.577	5.285	5.363	4.849	4.777	3.263
5.929	6.459	8.334	7.366	5.726	5.544	4.951	4.815	3.321
5.038	5.243	6.910	8.469	6.762	6.028	5.209	4.965	3.539
4.122	4.530	5.413	6.548	8.314	7.495	6.145	5.452	4.193
3.326	3.602	4.175	4.843	6.606	10.141	8.710	7.092	5.487
2.548	2.805	2.793	3.359	5.014	8.199	13.278	12.436	9.447
1.716	1.573	1.896	2.323	3.323	5.776	12.413	25.404	24.701
.857	.933	1.114	1.529	2.479	4.899	11.976	34.422	85.002

TABLE B.4.3BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=50.
WAVELENGTH = .68 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
OPTICAL DEPTH = .809

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
8.879	6.493	6.019	5.465	4.417	4.509	4.121	4.208	3.146
6.754	5.320	5.337	5.019	4.137	4.332	4.069	4.338	3.615
5.464	4.567	4.782	4.603	3.875	4.157	4.082	4.650	4.641
4.570	3.949	4.249	4.151	3.612	3.999	4.247	5.445	6.352
3.721	3.613	3.709	3.458	3.288	3.984	4.390	6.345	10.308
3.025	3.006	3.154	3.085	3.195	4.327	5.295	10.194	18.848
2.384	2.491	2.377	2.695	3.721	5.095	8.367	17.970	39.084
1.724	1.647	2.044	2.750	4.097	7.254	15.087	36.079	89.036
1.117	1.354	1.941	3.024	5.599	11.938	29.008	77.266	199.820
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
9.284	6.825	6.301	5.613	4.502	4.560	4.142	4.198	3.090
7.089	5.822	5.645	5.210	4.254	4.381	4.042	4.181	3.235
5.748	4.874	5.006	4.749	3.937	4.126	3.884	4.127	3.407
4.717	4.136	4.392	4.223	3.599	3.817	3.721	4.093	3.675
3.803	3.723	3.770	3.451	3.126	3.494	3.597	4.027	4.145
3.072	3.054	3.142	2.944	2.760	3.153	3.441	4.137	4.449
2.406	2.488	2.256	2.329	2.711	2.867	3.480	4.173	4.777
1.729	1.574	1.755	1.927	2.204	2.689	3.261	4.359	5.265
1.104	1.195	1.351	1.625	2.045	2.613	3.473	4.483	5.514
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
9.743	7.246	6.582	5.761	4.587	4.610	4.163	4.188	3.033
7.512	6.323	6.055	5.498	4.432	4.482	4.065	4.102	2.994
6.032	5.284	5.422	5.045	4.126	4.228	3.875	3.935	2.918
4.864	4.419	4.684	4.474	3.764	3.862	3.595	3.691	2.808
3.884	3.895	3.953	3.613	3.191	3.448	3.337	3.377	2.793
3.120	3.151	3.243	3.000	2.732	2.962	2.939	3.034	2.698
2.423	2.525	2.278	2.265	2.530	2.443	2.579	2.641	2.501
1.734	1.555	1.675	1.713	1.799	1.886	1.959	2.231	2.344
1.092	1.116	1.159	1.227	1.332	1.486	1.704	2.005	2.408
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
10.360	7.800	6.863	5.912	4.678	4.661	4.163	4.178	2.976
8.069	7.382	6.913	5.954	4.735	4.665	4.158	4.103	2.871
6.315	6.146	6.430	5.735	4.668	4.576	4.069	3.979	2.777
5.015	4.873	5.372	5.225	4.364	4.317	3.880	3.774	2.670
3.972	4.189	4.487	4.208	3.774	3.942	3.670	3.541	2.714
3.167	3.325	3.580	3.448	3.225	3.428	3.304	3.262	2.591
2.450	2.618	2.474	2.556	2.880	2.828	2.973	2.923	2.404
1.739	1.594	1.772	1.865	2.051	2.219	2.337	2.613	2.660
1.080	1.115	1.206	1.342	1.573	1.865	2.242	2.761	3.417
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX					
11.325	8.583	7.147	6.064	4.771	4.712	4.204	4.168	2.910
8.859	11.151	9.324	7.201	5.353	5.016	4.354	4.124	2.847
6.601	8.589	12.167	9.648	6.653	5.633	4.679	4.315	2.900
5.166	6.140	9.358	13.071	9.735	7.207	5.463	4.723	3.170
4.059	4.807	6.518	9.729	14.326	11.387	7.333	5.895	4.047
3.215	3.664	4.649	6.466	11.012	18.341	14.370	9.515	6.095
2.472	2.908	3.086	4.253	7.456	14.748	25.363	20.359	10.646
1.724	1.694	2.149	2.959	4.932	10.069	23.301	46.664	37.226
1.067	1.195	1.509	2.255	4.059	8.708	22.014	60.460	125.201

TABLE B.4.4 BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=.50.
WAVELENGTH = .80 MICROMETERS, VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
OPTICAL DEPTH = .222

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
12.632	11.622	12.432	12.278	11.158	11.610	11.008	11.158	10.614	
12.106	11.158	11.976	11.847	10.781	11.243	10.701	10.947	10.723	
11.260	10.403	11.188	11.085	10.108	10.575	10.141	10.560	10.990	
10.118	9.362	10.086	10.013	9.137	9.617	9.358	10.149	11.550	
8.946	8.847	9.081	8.621	8.111	8.812	9.022	10.218	14.141	
7.220	7.154	7.366	7.039	6.716	7.493	8.095	10.519	19.054	
5.016	5.160	4.701	4.744	5.474	5.788	7.474	12.344	31.245	
3.599	3.326	3.554	3.757	4.242	5.475	8.570	19.891	64.326	
1.581	1.695	1.882	2.244	3.159	5.561	12.684	37.209	129.525	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
12.660	11.654	12.465	12.301	11.176	11.623	11.015	11.152	10.570	
12.137	11.215	12.022	11.885	10.810	11.257	10.689	10.868	10.432	
11.292	10.448	11.231	11.119	10.126	10.563	10.061	10.296	10.070	
10.140	9.396	10.118	10.032	9.130	9.551	9.146	9.483	9.533	
8.960	8.970	9.096	8.616	8.056	8.636	8.508	8.819	9.560	
7.229	7.165	7.359	6.992	6.569	7.079	7.076	7.543	8.548	
5.021	5.156	4.661	4.624	5.139	4.993	5.344	5.712	6.825	
3.598	3.301	3.459	3.491	3.603	3.848	3.928	4.817	6.865	
1.574	1.638	1.686	1.768	1.926	2.184	2.639	3.457	5.610	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
12.693	11.691	12.497	12.324	11.193	11.637	11.022	11.146	10.526	
12.174	11.273	12.081	11.936	10.849	11.285	10.696	10.827	10.246	
11.324	10.505	11.297	11.178	10.172	10.592	10.054	10.198	9.694	
10.161	9.443	10.174	10.086	9.171	9.561	9.092	9.278	8.872	
8.975	8.903	9.135	8.653	8.070	8.613	8.399	8.487	8.537	
7.239	7.185	7.381	7.001	6.551	7.004	6.867	6.986	7.143	
5.025	5.161	4.660	4.596	5.070	4.832	4.973	4.939	4.951	
3.597	3.289	3.426	3.412	3.455	3.548	3.390	3.732	4.643	
1.567	1.605	1.611	1.620	1.660	1.744	1.879	2.163	3.249	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
12.739	11.734	12.530	12.349	11.212	11.650	11.029	11.141	10.483	
12.217	11.370	12.180	12.008	10.909	11.330	10.724	10.822	10.147	
11.356	10.603	11.424	11.298	10.274	10.674	10.111	10.208	9.575	
10.183	9.510	10.278	10.210	9.288	9.666	9.173	9.299	8.743	
8.990	8.953	9.225	8.761	8.189	8.725	8.486	8.529	8.428	
7.248	7.218	7.444	7.086	6.650	7.107	6.954	7.032	7.058	
5.029	5.179	4.698	4.653	5.138	4.908	5.053	4.978	4.884	
3.597	3.292	3.439	3.433	3.492	3.595	3.438	3.765	4.626	
1.560	1.592	1.601	1.615	1.673	1.775	1.932	2.254	3.443	
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX									
12.817	11.788	12.563	12.373	11.232	11.664	11.036	11.135	10.439	
12.272	11.651	12.379	12.156	11.010	11.407	10.781	10.854	10.120	
11.389	10.803	11.891	11.657	10.535	10.864	10.260	10.323	9.633	
10.205	9.652	10.644	10.603	9.842	10.080	9.492	9.574	8.979	
9.006	9.040	9.467	9.307	9.183	9.557	9.138	9.076	8.957	
7.258	7.275	7.599	7.460	7.465	8.602	8.293	8.163	8.173	
5.034	5.215	4.799	4.898	5.715	6.223	7.610	7.539	7.470	
3.596	3.310	3.503	3.605	3.900	4.609	6.034	9.525	11.997	
1.553	1.599	1.647	1.763	2.059	2.807	4.315	11.520	30.941	

TABLE 4.5 BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=50.
 WAVELENGTH = .30 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .361

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
12.358	11.204	11.825	11.568	10.412	10.693	9.971	9.907	9.860	
11.675	10.655	11.336	11.131	10.047	10.358	9.716	9.780	10.022	
10.766	9.885	10.564	10.405	9.424	9.763	9.261	9.550	10.394	
9.630	8.874	9.515	9.402	8.537	8.925	8.649	9.419	11.130	
8.491	8.372	8.568	8.112	7.519	8.263	8.536	9.865	14.027	
6.846	6.774	6.965	6.661	6.390	7.212	8.023	10.958	19.693	
4.766	4.904	4.493	4.578	5.371	5.918	8.156	14.394	33.603	
3.432	3.200	3.459	3.765	4.446	6.179	10.604	25.125	70.423	
1.551	1.699	1.977	2.513	3.848	7.305	17.258	48.978	143.716	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
12.420	11.267	11.886	11.606	10.437	10.710	9.977	9.896	9.810	
11.738	10.762	11.413	11.186	10.084	10.371	9.691	9.669	9.706	
10.826	9.961	10.629	10.449	9.440	9.735	9.140	9.199	9.399	
9.666	8.925	9.557	9.420	8.517	8.820	8.345	8.538	9.943	
8.513	8.404	8.583	8.095	7.528	8.000	7.804	8.014	9.023	
6.859	6.786	6.948	6.584	6.167	6.603	6.576	7.005	8.133	
4.771	4.894	4.428	4.394	4.870	4.750	5.110	5.513	6.614	
3.429	3.159	3.315	3.363	3.492	3.781	3.941	4.876	6.703	
1.540	1.615	1.685	1.806	2.019	2.346	2.906	3.739	5.581	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
12.490	11.343	11.947	11.644	10.462	10.727	9.993	9.884	9.760	
11.814	10.869	11.513	11.265	10.138	10.403	9.691	9.606	9.500	
10.887	10.059	10.735	10.535	9.499	9.765	9.115	9.057	8.986	
9.701	8.999	9.639	9.494	8.565	8.819	8.253	8.255	8.221	
8.535	8.451	8.635	8.140	7.536	7.952	7.634	7.567	7.911	
6.873	6.812	6.974	6.588	6.129	6.481	6.268	6.263	6.620	
4.777	4.899	4.420	4.344	4.753	4.506	4.579	4.480	4.532	
3.427	3.139	3.262	3.242	3.270	3.339	3.160	3.448	4.112	
1.530	1.566	1.574	1.587	1.631	1.716	1.848	2.104	3.028	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
12.586	11.435	12.008	11.683	10.490	10.744	9.989	9.875	9.710	
11.906	11.065	11.698	11.383	10.227	10.462	9.720	9.587	9.384	
10.946	10.242	10.962	10.714	9.653	9.874	9.179	9.049	8.840	
9.739	9.112	9.813	9.692	8.737	8.960	8.345	8.255	8.057	
8.559	8.530	8.777	8.304	7.706	8.100	7.734	7.590	7.764	
6.886	6.860	7.066	6.711	6.267	6.615	6.366	6.293	6.492	
4.782	4.922	4.471	4.421	4.849	4.602	4.671	4.516	4.486	
3.425	3.141	3.276	3.267	3.317	3.400	3.238	3.482	4.279	
1.520	1.548	1.561	1.584	1.656	1.772	1.942	2.263	3.328	
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX									
12.741	11.557	12.069	11.723	10.518	10.760	9.995	9.861	9.660	
12.029	11.659	12.115	11.656	10.390	10.571	9.789	9.614	9.341	
11.007	10.663	11.927	11.451	10.116	10.171	9.382	9.179	8.875	
9.776	9.379	10.553	11.088	9.812	9.672	8.825	8.607	8.233	
8.583	8.680	9.224	9.380	9.671	9.672	8.827	8.573	8.349	
6.899	6.950	7.330	7.393	7.848	9.525	8.843	8.114	7.678	
4.787	4.973	4.631	4.841	5.904	7.133	9.564	9.073	8.133	
3.423	3.165	3.374	3.550	4.036	5.279	8.179	14.051	15.696	
1.510	1.559	1.636	1.835	2.340	3.658	7.450	19.034	45.736	

TABLE B.4.6BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=.30.
 WAVELENGTH = .80 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .689

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
12.340	10.647	10.800	10.327	9.133	9.206	8.472	8.504	9.326	
11.087	9.806	10.192	9.853	8.776	8.915	8.285	8.462	9.507	
9.932	8.955	9.425	9.178	8.232	8.434	7.974	8.396	9.922	
8.752	7.974	8.461	8.295	7.489	7.787	7.604	8.553	10.730	
7.653	7.488	7.618	7.187	6.755	7.352	7.798	9.339	13.759	
6.152	6.065	6.221	5.972	5.812	6.728	7.864	11.319	19.773	
4.304	4.426	4.105	4.270	5.173	6.087	9.039	16.399	34.521	
3.126	2.967	3.282	3.765	4.767	7.245	13.336	30.383	73.200	
1.519	1.723	2.154	2.978	4.973	9.955	23.400	61.060	151.562	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
12.519	10.813	10.949	10.407	9.180	9.233	8.479	8.489	9.274	
11.254	10.070	10.360	9.957	8.836	8.931	8.246	8.321	9.184	
10.081	9.122	9.547	9.253	8.253	8.387	7.801	7.959	8.901	
8.832	8.075	8.534	8.321	7.453	7.625	7.174	7.458	8.482	
7.697	7.545	7.640	7.157	6.610	6.957	6.772	7.082	8.584	
6.177	6.083	6.192	5.847	5.464	5.817	5.830	6.356	7.761	
4.313	4.411	4.000	3.978	4.396	4.341	4.744	5.227	6.347	
3.124	2.902	3.053	3.134	3.295	3.655	3.926	4.867	6.453	
1.506	1.595	1.700	1.883	2.181	2.600	3.263	4.103	5.436	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
12.719	11.019	11.097	10.488	9.226	9.259	8.485	8.473	9.222	
11.461	10.333	10.581	10.114	8.931	8.979	8.241	8.238	8.971	
10.231	9.343	9.774	9.413	8.350	8.427	7.760	7.777	8.478	
8.912	8.230	8.693	8.453	7.529	7.618	7.039	7.103	7.743	
7.742	7.636	7.734	7.232	6.617	6.879	6.528	6.525	7.447	
6.202	6.131	6.236	5.852	5.403	5.631	5.399	5.436	6.208	
4.322	4.420	3.990	3.900	4.225	3.978	4.005	3.963	4.268	
3.122	2.874	2.973	2.947	2.958	3.007	2.875	3.109	3.993	
1.492	1.523	1.537	1.559	1.610	1.698	1.827	2.048	2.823	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
12.981	11.280	11.245	10.572	9.277	9.285	8.492	8.457	9.170	
11.723	10.857	11.032	10.365	9.098	9.076	8.281	8.212	8.850	
10.379	9.796	10.311	9.793	8.648	8.613	7.852	7.763	8.325	
8.994	8.478	9.070	8.865	7.857	7.861	7.176	7.100	7.574	
7.789	7.797	8.026	7.557	6.933	7.138	6.684	6.560	7.301	
6.227	6.223	6.416	6.091	5.662	5.868	5.563	5.496	6.097	
4.332	4.464	4.087	4.046	4.396	4.159	4.177	4.044	4.214	
3.120	2.882	3.007	3.006	3.065	3.148	3.026	3.243	4.076	
1.478	1.506	1.539	1.592	1.711	1.874	2.092	2.445	3.399	
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX						
13.371	11.637	11.393	10.655	9.327	9.311	8.499	8.441	9.118	
12.084	12.492	12.185	11.023	9.440	9.271	8.385	8.242	8.803	
10.528	10.962	12.912	11.728	9.713	9.203	8.192	7.941	8.363	
9.077	9.143	11.036	12.523	10.565	9.433	8.081	7.642	7.847	
7.837	8.135	9.107	10.329	11.940	10.951	8.986	7.922	8.087	
6.251	6.409	7.004	7.714	9.628	13.056	11.290	9.049	8.209	
4.341	4.565	4.424	4.990	6.387	10.335	15.708	13.718	10.312	
3.119	2.931	3.212	3.621	4.696	7.524	14.491	25.845	23.834	
1.465	1.541	1.709	2.140	3.215	6.029	13.959	36.031	72.593	

TABLE B.5. BRDF-ATMOSPHERE ANALYSIS FOR A PLANKTONIC GRASS CANOPY LAI=1.2
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .259

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
4.956	4.747	4.555	4.218	4.040	4.009	4.356	4.457	5.282
4.473	4.382	4.270	3.980	3.838	3.844	4.241	4.480	6.139
4.015	3.999	3.928	3.685	3.586	3.644	4.122	4.602	6.944
3.547	3.563	3.493	3.336	3.262	3.402	4.047	5.003	8.298
3.039	3.074	3.040	2.918	2.955	3.223	4.127	5.750	11.380
2.470	2.520	2.549	2.515	2.649	3.182	4.466	7.614	13.371
1.857	1.872	2.062	1.963	2.685	3.382	5.433	12.056	34.953
1.362	1.308	1.487	1.894	2.499	4.030	8.431	22.635	76.049
.771	.882	1.159	1.662	2.864	5.931	14.970	46.239	163.763
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
5.028	4.817	4.623	4.265	4.077	4.039	4.377	4.462	5.739
4.542	4.501	4.365	4.059	3.905	3.890	4.249	4.396	5.796
4.082	4.092	4.019	3.763	3.641	3.656	4.040	4.275	5.319
3.590	3.635	3.566	3.392	3.294	3.340	3.794	4.140	5.371
3.069	3.128	3.086	2.938	2.905	3.004	3.448	3.936	5.938
2.492	2.552	2.560	2.471	2.466	2.632	3.135	3.845	5.936
1.870	1.880	2.021	1.812	2.238	2.336	2.683	3.724	5.927
1.366	1.291	1.366	1.539	1.657	1.923	2.509	3.648	6.024
.765	.811	.900	1.045	1.289	1.663	2.308	3.435	5.711
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
5.111	4.901	4.691	4.311	4.113	4.070	4.398	4.466	5.696
4.627	4.621	4.483	4.164	3.990	3.957	4.239	4.372	5.593
4.148	4.207	4.154	3.888	3.747	3.740	4.073	4.196	5.391
3.633	3.731	3.684	3.513	3.389	3.403	3.758	3.915	5.095
3.099	3.198	3.177	3.034	2.970	3.023	3.350	3.546	4.717
2.513	2.601	2.622	2.522	2.485	2.574	2.899	3.155	4.256
1.882	1.965	2.045	1.803	2.178	2.154	2.223	2.743	3.821
1.370	1.278	1.340	1.454	1.482	1.545	1.821	2.278	3.367
.760	.775	.812	.862	.952	1.104	1.345	1.819	2.392
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
5.229	5.005	4.759	4.360	4.153	4.101	4.420	4.470	5.633
4.731	4.839	4.690	4.309	4.115	4.060	4.367	4.406	5.511
4.214	4.410	4.413	4.110	3.960	3.919	4.220	4.272	5.319
3.678	3.866	3.896	3.768	3.635	3.635	3.964	4.045	5.048
3.131	3.303	3.362	3.261	3.226	3.279	3.583	3.733	4.738
2.535	2.674	2.759	2.711	2.711	2.823	3.143	3.372	4.340
1.895	1.952	2.138	1.942	2.354	2.363	2.465	2.973	3.770
1.374	1.300	1.389	1.532	1.605	1.710	2.020	2.508	3.622
.754	.771	.825	.899	1.036	1.242	1.555	2.154	3.517
AZIMUTH = 150.00 DEGREES			TOTAL RADIANCE MATRIX					
5.431	5.144	4.828	4.409	4.194	4.131	4.441	4.474	5.610
4.871	5.056	5.161	4.615	4.317	4.219	4.495	4.501	5.535
4.282	4.382	5.051	4.939	4.494	4.304	4.533	4.539	5.519
3.723	4.160	4.721	5.402	4.858	4.481	4.510	4.622	5.560
3.164	3.480	3.862	4.468	5.535	5.091	4.911	4.834	5.304
2.556	2.793	3.074	3.480	4.493	6.263	5.125	5.246	5.276
1.907	2.030	2.350	2.442	3.538	5.214	5.305	6.411	8.731
1.376	1.346	1.533	1.888	2.431	3.771	7.555	15.365	18.364
.748	.800	.934	1.202	1.786	3.204	7.262	20.692	55.412

TABLE B.5.2BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=1.2
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .429

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
5.580	4.949	4.536	4.099	3.854	3.764	4.013	4.040	5.212
4.698	4.379	4.156	3.816	3.640	3.613	3.938	4.132	5.613
4.047	3.913	3.780	3.518	3.408	3.454	3.896	4.379	6.503
3.501	3.451	3.353	3.195	3.131	3.289	3.953	5.023	8.003
2.971	2.971	2.931	2.827	2.897	3.233	4.284	6.143	11.463
2.417	2.454	2.490	2.497	2.709	3.416	5.010	8.858	19.333
1.845	1.868	2.077	2.071	2.928	3.953	6.798	15.099	38.113
1.397	1.380	1.620	2.171	3.063	5.302	11.447	29.791	84.691
.890	1.051	1.453	2.190	3.960	8.457	21.334	62.436	185.913
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
5.735	5.087	4.661	4.174	3.905	3.800	4.033	4.036	5.159
4.836	4.600	4.309	3.927	3.721	3.656	3.928	4.008	5.242
4.171	4.064	3.909	3.615	3.462	3.445	3.758	3.943	5.297
3.572	3.554	3.445	3.252	3.135	3.175	3.568	3.893	5.395
3.015	3.041	2.979	2.832	2.799	2.898	3.319	3.793	5.522
2.446	2.489	2.489	2.412	2.423	2.603	3.119	3.857	5.538
1.860	1.869	2.003	1.935	2.254	2.409	2.945	3.894	5.614
1.400	1.334	1.432	1.631	1.797	2.159	2.832	4.025	5.836
.881	.945	1.064	1.262	1.584	2.056	2.832	3.996	5.646
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
5.912	5.257	4.786	4.249	3.955	3.836	4.053	4.032	5.106
5.007	4.820	4.507	4.084	3.833	3.733	3.957	3.952	5.011
4.295	4.258	4.122	3.789	3.591	3.530	3.768	3.796	4.824
3.643	3.703	3.611	3.409	3.254	3.224	3.492	3.568	4.551
3.059	3.139	3.094	2.944	2.857	2.883	3.141	3.259	4.201
2.474	2.550	2.559	2.458	2.416	2.483	2.755	2.937	3.778
1.874	1.894	2.021	1.798	2.139	2.119	2.176	2.606	3.198
1.403	1.322	1.382	1.490	1.523	1.595	1.854	2.235	2.780
.871	.889	.931	.989	1.088	1.248	1.489	1.906	2.619
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
6.157	5.473	4.911	4.327	4.011	3.873	4.072	4.027	5.054
5.224	5.254	4.887	4.317	4.010	3.858	4.035	3.965	4.900
4.418	4.636	4.582	4.142	3.898	3.759	3.924	3.852	4.703
3.717	3.925	3.955	3.803	3.602	3.519	3.714	3.662	4.437
3.107	3.296	3.377	3.274	3.206	3.204	3.394	3.411	4.143
2.503	2.651	2.751	2.718	2.715	2.789	3.021	3.127	3.777
1.888	1.952	2.140	1.977	2.358	2.368	2.446	2.816	3.271
1.406	1.345	1.439	1.582	1.673	1.793	2.093	2.475	3.129
.862	.881	.947	1.038	1.205	1.442	1.780	2.353	3.341
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX					
6.562	5.772	5.037	4.405	4.066	3.909	4.092	4.023	5.001
5.524	6.749	5.850	4.875	4.330	4.075	4.185	4.047	4.870
4.543	5.606	6.905	5.773	4.832	4.339	4.327	4.133	4.844
3.791	4.476	6.595	7.064	5.930	4.944	4.648	4.351	4.909
3.156	3.593	4.286	5.615	7.720	6.566	5.557	4.707	5.239
2.531	2.831	3.273	4.096	6.111	9.397	8.241	6.556	6.320
1.903	2.051	2.462	2.808	4.478	7.742	13.347	12.173	12.025
1.409	1.404	1.645	2.143	3.076	5.511	12.329	25.333	25.051
.852	.921	1.108	1.520	2.471	4.893	11.959	34.408	35.001

TABLE B.5.3 PROF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI = 1.2
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 M.
 OPTICAL DEPTH = .909

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
7.561	5.684	4.671	3.976	3.592	3.411	3.553	3.574	4.730	
5.479	4.538	4.033	3.578	3.338	3.270	3.524	3.725	5.148	
4.272	3.836	3.562	3.256	3.128	3.164	3.573	4.077	6.074	
3.500	3.292	3.129	2.966	2.918	3.107	3.789	4.931	7.638	
2.894	2.813	2.752	2.674	2.795	3.222	4.423	6.390	11.292	
2.349	2.352	2.392	2.460	2.786	3.720	5.616	9.632	19.624	
1.840	1.865	2.100	2.239	3.282	4.726	8.394	17.655	39.620	
1.471	1.508	1.839	2.604	3.899	7.045	15.021	36.006	99.352	
1.111	1.345	1.936	3.018	5.592	11.935	29.003	77.262	199.922	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
7.967	6.017	4.952	4.124	3.677	3.462	3.579	3.564	4.673	
5.813	5.039	4.340	3.769	3.455	3.318	3.497	3.568	4.768	
4.556	4.143	3.787	3.401	3.190	3.133	3.375	3.554	4.839	
3.647	3.479	3.272	3.038	2.905	2.925	3.264	3.579	4.942	
2.976	2.924	2.814	2.667	2.632	2.732	3.122	3.573	5.120	
2.396	2.400	2.380	2.319	2.351	2.546	3.062	3.775	5.225	
1.862	1.963	1.979	1.873	2.272	2.499	3.007	3.958	5.330	
1.476	1.436	1.550	1.790	2.007	2.480	3.195	4.236	5.580	
1.099	1.187	1.346	1.618	2.039	2.610	3.468	4.479	5.815	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
8.425	6.438	5.234	4.272	3.761	3.513	3.600	3.554	4.616	
6.236	5.541	4.750	4.057	3.633	3.419	3.521	3.489	4.527	
4.840	4.552	4.202	3.698	3.379	3.235	3.365	3.362	4.350	
3.794	3.762	3.564	3.288	3.070	2.971	3.137	3.176	4.094	
3.057	3.095	2.996	2.929	2.637	2.687	2.961	2.923	3.797	
2.444	2.497	2.481	2.375	2.323	2.355	2.560	2.670	3.674	
1.884	1.899	2.001	1.809	2.091	2.173	2.106	2.426	3.642	
1.431	1.417	1.471	1.567	1.602	1.677	1.893	2.153	3.659	
1.087	1.107	1.154	1.220	1.326	1.483	1.693	1.977	3.409	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
9.042	6.991	5.515	4.423	3.853	3.563	3.620	3.544	4.560	
6.793	6.600	5.608	4.513	3.936	3.602	3.613	3.490	4.493	
5.123	5.415	5.210	4.398	3.922	3.582	3.560	3.405	4.210	
3.944	4.216	4.252	4.039	3.670	3.426	3.423	3.259	3.957	
3.145	3.389	3.530	3.424	3.291	3.181	3.195	3.087	3.689	
2.491	2.671	2.818	2.823	2.816	2.822	2.925	2.900	3.367	
1.906	1.992	2.197	2.100	2.441	2.459	2.500	2.708	3.340	
1.486	1.455	1.567	1.719	1.853	2.010	2.271	2.540	3.376	
1.074	1.106	1.201	1.335	1.567	1.862	2.237	2.753	3.413	
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX						
10.007	7.775	5.799	4.575	3.945	3.614	3.641	3.534	4.503	
7.533	10.368	8.017	5.760	4.554	3.954	3.909	3.571	4.790	
5.408	7.857	10.948	6.301	5.906	4.940	4.170	3.742	4.532	
4.095	5.483	8.238	11.886	9.042	6.316	5.026	4.209	4.458	
3.232	4.007	5.562	8.945	13.832	10.625	7.357	5.440	5.021	
2.538	3.010	3.887	5.841	10.603	17.735	13.691	9.152	11.371	
1.923	2.182	2.809	3.802	7.017	14.379	25.910	20.644	17.137	
1.491	1.555	1.944	2.815	4.734	9.860	23.776	46.590	37.520	
1.062	1.187	1.504	2.253	4.055	8.705	22.109	60.451	103.111	

TABLE 5.4 BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI = 1.2
WAVELENGTH = .90 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
OPTICAL DEPTH = .222

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
15.808	15.873	15.865	15.106	14.948	14.812	15.124	15.387	20.959	
15.184	15.277	15.303	14.587	14.453	14.346	14.690	15.045	20.747	
14.144	14.262	14.306	13.652	13.549	13.483	13.878	14.399	20.382	
12.640	12.764	12.819	12.225	12.188	12.189	12.681	13.527	19.986	
10.844	10.964	11.029	10.544	10.563	10.667	11.362	12.712	20.681	
8.713	8.824	8.900	8.553	8.656	8.954	9.948	12.514	24.312	
6.088	6.242	6.377	6.037	6.773	7.096	9.563	13.992	34.981	
4.255	4.137	4.305	4.608	4.979	6.065	9.542	20.877	66.590	
1.527	1.606	1.833	2.171	3.093	5.556	12.622	37.176	129.588	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
15.936	15.904	15.898	15.129	14.965	14.826	15.131	15.381	20.915	
15.215	15.334	15.350	14.624	14.482	14.360	14.679	14.966	20.456	
14.176	14.308	14.348	13.686	13.566	13.470	13.799	14.136	19.462	
12.661	12.798	12.851	12.243	12.181	12.124	12.469	12.861	17.969	
10.858	10.988	11.044	10.539	10.507	10.491	10.848	11.313	16.100	
8.722	8.835	8.893	8.506	8.509	8.540	8.930	9.538	13.306	
6.092	6.238	6.337	5.916	6.437	6.301	6.432	7.361	10.561	
4.255	4.111	4.210	4.342	4.340	4.438	4.900	5.803	9.129	
1.520	1.550	1.637	1.695	1.861	2.179	2.577	3.424	6.673	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
15.869	15.941	15.931	15.152	14.982	14.839	15.133	15.375	20.871	
15.252	15.392	15.408	14.675	14.521	14.388	14.684	14.924	20.270	
14.208	14.364	14.415	13.745	13.612	13.499	13.791	14.037	19.086	
12.682	12.844	12.906	12.297	12.222	12.134	12.415	12.655	17.308	
10.872	11.020	11.084	10.576	10.521	10.468	10.738	10.992	15.077	
8.732	8.855	8.915	8.515	8.491	8.465	8.720	8.921	12.407	
6.096	6.243	6.336	5.888	6.368	6.140	6.062	6.586	8.637	
4.254	4.099	4.177	4.263	4.192	4.138	4.362	4.716	6.908	
1.513	1.516	1.562	1.547	1.595	1.740	1.817	2.129	3.312	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
15.915	15.984	15.964	15.176	15.002	14.853	15.145	15.369	20.827	
15.295	15.489	15.507	14.748	14.581	14.433	14.713	14.920	20.171	
14.240	14.462	14.541	13.855	13.715	13.531	13.849	14.047	18.967	
12.704	12.911	13.011	12.421	12.339	12.238	12.496	12.677	17.179	
10.888	11.071	11.173	10.684	10.640	10.579	10.826	11.023	14.948	
8.741	8.888	8.977	8.601	8.590	8.568	8.807	9.029	12.317	
6.101	6.261	6.374	5.945	6.437	6.216	6.141	6.626	8.620	
4.253	4.102	4.190	4.285	4.229	4.185	4.410	4.751	6.890	
1.506	1.504	1.552	1.542	1.607	1.770	1.870	2.220	3.506	
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX									
15.993	16.039	15.997	15.200	15.021	14.866	15.152	15.363	20.793	
15.350	15.770	15.707	14.895	14.682	14.510	14.770	14.951	20.144	
14.272	14.662	15.009	14.223	13.976	13.771	13.997	14.162	19.025	
12.726	13.053	13.377	13.114	12.894	12.652	12.815	12.952	17.415	
10.904	11.158	11.416	11.231	11.634	11.411	11.478	11.570	15.498	
8.751	8.945	9.133	8.974	9.405	10.063	10.146	10.156	13.432	
6.105	6.297	6.474	6.190	7.013	7.521	8.698	9.187	11.214	
4.252	4.121	4.253	4.456	4.637	5.129	7.005	10.511	14.262	
1.500	1.510	1.598	1.690	1.993	2.802	4.853	11.557	31.005	

TABLE B.5.5 BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=1.2
 WAVELENGTH = .30 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .361

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
15.362	15.217	15.057	14.214	13.927	13.626	13.667	13.617	19.387	
14.585	14.542	14.467	13.695	13.453	13.199	13.298	13.374	19.445	
13.492	13.526	13.497	12.804	12.613	12.425	12.615	12.917	19.219	
12.011	12.090	12.083	11.468	11.363	11.277	11.630	12.378	19.049	
10.281	10.366	10.397	9.907	9.887	9.957	10.633	12.048	20.164	
8.251	8.344	8.402	8.071	8.181	8.543	9.680	12.710	24.616	
5.770	5.916	6.055	5.776	6.566	7.105	9.124	15.827	37.080	
4.042	3.952	4.154	4.548	5.118	6.710	11.462	25.976	72.524	
1.502	1.620	1.934	2.448	3.790	7.301	17.205	49.950	143.773	
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
15.423	15.280	15.118	14.252	13.952	13.643	13.675	13.606	19.537	
14.648	14.650	14.545	13.750	13.490	13.212	13.274	13.263	19.129	
13.552	13.602	13.560	12.950	12.629	12.397	12.495	12.566	18.224	
12.047	12.131	12.125	11.487	11.343	11.172	11.325	11.498	18.862	
10.303	10.398	10.412	9.890	9.796	9.695	9.901	10.198	15.159	
8.264	8.355	8.385	7.994	7.958	7.935	8.233	8.748	13.061	
5.775	5.907	5.990	5.592	6.064	6.937	8.079	8.946	16.089	
4.040	3.911	4.009	4.147	4.165	4.312	4.799	5.727	18.804	
1.492	1.536	1.641	1.740	1.961	2.342	2.353	3.761	5.637	
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
15.494	15.356	15.179	14.290	13.977	13.660	13.681	13.594	19.486	
14.724	14.757	14.644	13.829	13.543	13.244	13.273	13.200	18.922	
13.612	13.700	13.668	12.936	12.688	12.426	12.470	12.423	17.911	
12.082	12.205	12.208	11.560	11.591	11.172	11.233	11.214	16.141	
10.325	10.445	10.465	9.935	9.803	9.646	9.731	9.750	14.048	
8.278	8.361	8.411	7.998	7.919	7.812	7.925	8.006	11.343	
5.790	5.911	5.983	5.542	5.953	6.693	6.548	6.922	13.155	
4.038	3.891	3.957	4.025	3.942	3.671	4.038	4.299	13.094	
1.461	1.486	1.531	1.522	1.574	1.712	1.795	2.076	3.063	
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX						
15.590	15.448	15.240	14.329	14.005	13.677	13.687	13.595	19.456	
14.816	14.953	14.829	13.947	13.632	13.303	13.302	13.182	18.306	
13.672	13.883	13.895	13.115	12.843	12.515	12.534	12.416	17.665	
12.120	12.318	12.321	11.759	11.564	11.312	11.326	11.215	15.977	
10.349	10.524	10.606	10.099	9.973	9.794	9.831	9.773	13.901	
8.291	8.429	8.503	8.121	8.058	7.946	8.023	8.036	11.415	
5.785	5.935	6.034	5.619	6.043	6.789	6.640	6.948	12.962	
4.036	3.893	3.971	4.050	3.989	3.931	4.096	4.332	13.000	
1.472	1.468	1.518	1.519	1.598	1.768	1.889	2.025	3.385	
AZIMUTH = 150.00 DEGREES			TOTAL RADIANCE MATRIX						
15.745	15.570	15.301	14.369	14.034	13.695	13.695	13.571	19.386	
14.939	15.546	15.247	14.220	13.799	13.413	13.371	13.232	18.763	
13.732	14.304	14.860	13.852	13.306	12.833	12.737	12.545	17.700	
12.157	12.585	13.121	13.155	12.638	12.025	11.806	11.566	16.303	
10.375	10.674	11.053	11.176	11.938	11.367	10.924	10.556	14.485	
8.304	8.519	8.767	8.803	9.633	10.357	10.500	9.867	12.821	
5.790	5.996	6.194	6.037	7.098	8.320	10.333	10.506	11.655	
4.034	3.916	4.067	4.333	4.703	5.811	8.037	14.771	17.757	
1.462	1.480	1.593	1.770	2.283	3.654	7.377	19.006	45.777	

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TABLE B.5.6BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPILE GRASS CANOPY LAI=1.2
WAVELENGTH = .80 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
OPTICAL DEPTH = .689

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
15.016	14.210	13.658	12.644	12.171	11.702	11.571	11.661	18.863	
13.678	13.257	12.959	12.097	11.717	11.332	11.296	11.518	18.742	
12.357	12.183	12.014	11.278	10.984	10.696	10.782	11.255	18.562	
10.816	10.812	10.724	10.099	9.923	9.782	10.093	11.062	18.469	
9.238	9.249	9.225	8.749	8.703	8.785	9.546	11.236	19.748	
7.390	7.444	7.478	7.193	7.342	7.849	9.239	12.786	24.554	
5.179	5.308	5.456	5.296	6.186	7.076	9.235	17.592	37.848	
3.650	3.609	3.873	4.425	5.327	7.680	14.028	31.081	75.201	
1.481	1.660	2.120	2.927	4.929	9.952	23.360	61.039	151.613	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
15.195	14.376	13.806	12.725	12.217	11.728	11.578	11.645	18.811	
13.845	13.520	13.127	12.201	11.777	11.348	11.247	11.378	18.419	
12.506	12.350	12.136	11.352	11.005	10.648	10.609	10.818	17.541	
10.946	10.913	10.798	10.125	9.887	9.620	9.664	9.967	16.221	
9.282	9.307	9.248	8.719	8.557	8.390	8.520	8.929	14.573	
7.415	7.463	7.449	7.068	6.995	6.938	7.205	7.822	12.541	
5.188	5.292	5.351	5.004	5.409	5.330	5.539	6.421	9.673	
3.648	3.545	3.643	3.794	3.855	4.090	4.613	5.565	8.454	
1.467	1.532	1.666	1.832	2.136	2.597	3.223	4.082	5.487	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
15.395	14.582	13.955	12.805	12.264	11.755	11.585	11.629	18.759	
14.052	13.783	13.348	12.358	11.873	11.396	11.242	11.295	18.206	
12.655	12.571	12.363	11.513	11.101	10.688	10.568	10.637	17.118	
11.026	11.067	10.956	10.256	9.963	9.613	9.529	9.612	15.483	
9.327	9.398	9.341	8.795	8.564	8.313	8.276	8.371	13.435	
7.440	7.510	7.493	7.073	6.933	6.752	6.773	6.902	10.929	
5.198	5.301	5.341	4.926	5.237	4.967	4.800	5.156	7.533	
3.646	3.516	3.564	3.608	3.518	3.442	3.567	3.807	5.993	
1.453	1.460	1.503	1.508	1.565	1.695	1.787	2.027	2.874	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
15.657	14.843	14.102	12.889	12.314	11.731	11.592	11.613	18.707	
14.314	14.307	13.800	12.609	12.039	11.492	11.282	11.269	18.085	
12.803	13.024	12.900	11.892	11.400	10.875	10.660	10.623	16.963	
11.108	11.316	11.333	10.668	10.291	9.856	9.666	9.609	15.313	
9.375	9.559	9.634	9.119	8.881	8.572	8.432	8.407	13.290	
7.465	7.602	7.673	7.312	7.192	6.989	6.937	6.963	10.877	
5.207	5.346	5.438	5.072	5.408	5.148	4.972	5.238	7.541	
3.644	3.525	3.598	3.666	3.625	3.584	3.718	3.940	6.076	
1.440	1.443	1.505	1.541	1.647	1.871	2.052	2.424	3.456	
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX									
15.047	15.201	14.251	12.973	12.365	11.807	11.599	11.593	18.654	
14.675	15.942	14.952	13.267	12.381	11.688	11.385	11.298	18.038	
12.952	14.191	15.501	13.827	12.465	11.464	11.000	10.801	17.003	
11.191	11.981	13.299	14.326	12.999	11.429	10.571	10.151	15.586	
9.423	9.897	10.715	11.891	13.888	12.384	10.734	9.769	14.076	
7.489	7.798	8.261	8.935	11.158	14.177	12.665	10.515	12.980	
5.216	5.447	5.773	6.013	7.900	11.324	16.503	14.711	13.639	
3.643	3.573	3.803	4.291	5.255	7.959	15.183	26.540	25.837	
1.423	1.478	1.674	2.097	3.170	6.026	13.919	36.010	12.710	

TABLE 6.1 BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=4.0
WAVELENGTH = .68 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
OPTICAL DEPTH = .259

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
4.839	4.317	4.090	3.988	3.928	3.900	4.014	4.427	6.609
4.359	3.965	3.820	3.757	3.729	3.739	3.910	4.450	6.940
3.908	3.610	3.506	3.476	3.484	3.546	3.813	4.575	7.694
3.515	3.244	3.176	3.180	3.232	3.372	3.797	5.003	9.973
2.984	2.800	2.769	2.811	2.929	3.197	3.959	5.836	12.178
2.360	2.322	2.331	2.429	2.628	3.182	4.312	7.665	18.927
1.873	1.872	1.936	2.118	2.517	3.352	5.530	12.107	35.561
1.287	1.336	1.478	1.821	2.464	4.065	8.423	22.628	76.148
.755	.866	1.138	1.650	2.854	5.912	14.956	46.281	163.766
AZIMUTH = 30.00 DEGREES			TOTAL RADIANCE MATRIX					
4.910	4.387	4.158	4.035	3.964	3.931	4.036	4.431	6.566
4.428	4.085	3.915	3.836	3.796	3.785	3.919	4.367	6.597
3.975	3.702	3.596	3.555	3.539	3.558	3.730	4.247	6.568
3.556	3.316	3.250	3.236	3.253	3.310	3.533	4.140	6.546
3.014	2.854	2.814	2.831	2.878	2.978	3.281	4.042	6.727
2.382	2.354	2.341	2.385	2.445	2.632	2.992	3.996	6.492
1.886	1.880	1.894	1.967	2.070	2.307	2.781	3.773	6.475
1.291	1.309	1.357	1.466	1.622	1.958	2.501	3.641	6.123
.750	.795	.880	1.033	1.279	1.644	2.295	3.427	5.714
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
4.994	4.471	4.226	4.082	4.001	3.961	4.057	4.436	6.523
4.513	4.204	4.033	3.941	3.881	3.854	3.958	4.342	6.394
4.041	3.817	3.732	3.680	3.646	3.641	3.764	4.159	6.140
3.601	3.412	3.367	3.357	3.358	3.373	3.508	3.915	5.770
3.043	2.924	2.905	2.926	2.944	2.997	3.183	3.651	5.506
2.403	2.403	2.403	2.436	2.464	2.574	2.745	3.206	4.912
1.898	1.905	1.919	1.958	2.010	2.124	2.320	2.748	4.323
1.295	1.306	1.331	1.381	1.446	1.530	1.613	2.270	3.446
.744	.759	.792	.850	.942	1.094	1.331	1.811	2.701
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
5.111	4.575	4.294	4.131	4.041	3.992	4.079	4.440	6.479
4.617	4.423	4.239	4.087	4.006	3.955	4.036	4.377	6.312
4.109	4.020	3.991	3.902	3.858	3.821	3.911	4.244	6.067
3.646	3.546	3.579	3.611	3.605	3.606	3.713	4.045	5.723
3.076	3.029	3.091	3.153	3.200	3.252	3.416	3.839	5.527
2.424	2.476	2.540	2.625	2.690	2.823	2.999	3.423	4.896
1.911	1.952	2.012	2.098	2.186	2.333	2.565	3.022	4.377
1.299	1.328	1.380	1.459	1.570	1.744	2.012	2.501	3.701
.738	.756	.805	.887	1.026	1.223	1.541	2.146	3.514
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX					
5.313	4.715	4.363	4.180	4.081	4.023	4.100	4.444	6.436
4.757	5.139	4.710	4.393	4.208	4.114	4.165	4.472	6.336
4.175	4.492	5.129	4.731	4.392	4.205	4.224	4.512	6.269
3.691	3.841	4.404	5.246	4.827	4.451	4.359	4.622	6.255
3.109	3.206	3.591	4.361	5.508	5.066	4.744	4.740	6.593
2.446	2.595	2.856	3.394	4.472	6.268	5.882	5.699	7.031
1.923	2.030	2.223	2.598	3.370	5.135	3.402	3.457	6.339
1.303	1.374	1.523	1.815	2.395	3.305	7.545	15.350	19.463
.732	.734	.814	1.190	1.775	3.185	7.249	20.633	59.941

TABLE B.6.29RDF-ATMOSPHERE ANALYSIS FOR A PLANOPILE GRASS CANOPY LAI=4.0
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .429

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX								
5.471	4.552	4.108	3.889	3.752	3.667	3.715	4.014	5.984
4.593	3.995	3.741	3.613	3.542	3.519	3.648	4.107	6.361
3.948	3.553	3.392	3.328	3.316	3.366	3.625	4.355	7.203
3.471	3.156	3.062	3.052	3.103	3.263	3.734	5.023	8.633
2.920	2.719	2.681	2.729	2.873	3.210	4.138	6.233	12.198
2.316	2.272	2.290	2.418	2.690	3.416	4.876	8.902	19.849
1.860	1.868	1.962	2.212	2.777	3.927	6.882	15.141	38.675
1.329	1.406	1.612	2.105	3.031	5.332	11.440	29.785	84.732
.877	1.038	1.435	2.179	3.952	8.441	21.323	62.430	185.916
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX								
5.626	4.690	4.233	3.964	3.803	3.703	3.734	4.010	5.931
4.731	4.215	3.895	3.724	3.622	3.563	3.639	3.983	5.990
4.072	3.704	3.520	3.425	3.369	3.357	3.488	3.920	5.997
3.545	3.260	3.154	3.110	3.107	3.148	3.349	3.893	6.025
2.964	2.789	2.729	2.735	2.775	2.876	3.173	3.884	6.257
2.344	2.307	2.289	2.334	2.404	2.603	2.986	3.900	6.104
1.874	1.869	1.988	1.975	2.103	2.383	2.929	3.936	6.176
1.332	1.360	1.424	1.565	1.765	2.189	2.825	4.019	5.927
.867	.931	1.046	1.252	1.576	2.040	2.821	3.939	5.649
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX								
5.803	4.860	4.358	4.039	3.853	3.739	3.754	4.006	5.879
4.901	4.436	4.092	3.881	3.734	3.639	3.668	3.927	5.759
4.196	3.898	3.734	3.599	3.499	3.442	3.497	3.773	5.524
3.614	3.408	3.320	3.267	3.226	3.197	3.272	3.568	5.180
3.009	2.887	2.844	2.846	2.833	2.861	2.995	3.348	4.937
2.373	2.368	2.359	2.380	2.397	2.483	2.622	2.960	4.294
1.889	1.894	1.906	1.939	1.999	2.093	2.260	2.651	3.759
1.335	1.347	1.374	1.425	1.492	1.625	1.847	2.229	3.071
.859	.876	.913	.978	1.079	1.231	1.476	1.899	2.622
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX								
6.048	5.076	4.483	4.117	3.909	3.776	3.774	4.002	5.826
5.119	4.870	4.472	4.113	3.911	3.764	3.746	3.940	5.648
4.319	4.276	4.194	3.952	3.806	3.670	3.653	3.829	5.403
3.687	3.630	3.664	3.660	3.574	3.493	3.495	3.662	5.067
3.057	3.044	3.127	3.176	3.182	3.181	3.248	3.502	4.879
2.401	2.469	2.551	2.640	2.696	2.789	2.888	3.170	4.294
1.903	1.952	2.025	2.118	2.207	2.342	2.530	2.856	3.833
1.338	1.370	1.430	1.516	1.641	1.823	2.076	2.469	3.290
.848	.868	.929	1.027	1.197	1.426	1.766	2.347	3.344
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX								
6.453	5.375	4.609	4.195	3.965	3.812	3.793	3.997	5.774
5.419	6.364	5.435	4.672	4.231	3.981	3.893	4.022	5.638
4.444	5.246	6.517	5.583	4.740	4.251	4.056	4.109	5.544
3.761	4.181	5.304	6.922	5.903	4.918	4.429	4.351	5.539
3.105	3.341	4.037	5.518	7.696	6.543	5.411	4.998	5.974
2.430	2.649	3.073	4.018	6.092	9.397	8.107	6.699	6.807
1.917	2.061	2.347	2.949	4.327	7.716	13.471	12.216	10.591
1.341	1.429	1.637	2.077	3.045	5.541	12.322	25.367	25.146
.839	.908	1.090	1.510	2.463	4.677	11.956	34.421	35.706

TABLE B.6.3 BRDF-ATMOSPHERE ANALYSIS FOR A PLAYOFFILE GRASS CANOPY LAI=4.1
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 M
 OPTICAL DEPTH = .909

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
7.468	5.343	4.305	3.799	3.507	3.331	3.314	3.552	5.460
5.388	4.208	3.679	3.406	3.256	3.192	3.285	3.704	5.855
4.187	3.528	3.231	3.095	3.051	3.092	3.352	4.058	6.734
3.474	3.040	2.882	2.846	2.895	3.086	3.611	4.931	8.231
2.850	2.598	2.541	2.591	2.775	3.204	4.305	6.466	11.973
2.262	2.197	2.224	2.395	2.770	3.720	5.508	9.868	20.106
1.853	1.865	2.004	2.356	3.159	4.705	8.461	17.689	40.140
1.415	1.529	1.832	2.551	3.874	7.068	15.016	36.001	89.434
1.101	1.335	1.923	3.010	5.586	11.923	28.995	77.257	199.824
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
7.873	5.676	4.587	3.946	3.591	3.382	3.335	3.542	5.403
5.722	4.709	3.986	3.597	3.373	3.241	3.261	3.547	5.415
4.471	3.834	3.456	3.241	3.113	3.060	3.154	3.534	5.500
3.621	3.227	3.024	2.913	2.882	2.904	3.095	3.579	5.555
2.932	2.709	2.603	2.584	2.613	2.713	3.003	3.648	5.810
2.310	2.246	2.211	2.254	2.336	2.546	2.954	3.911	5.708
1.874	1.863	1.983	1.990	2.149	2.477	3.074	3.992	5.833
1.420	1.456	1.543	1.727	1.981	2.503	3.190	4.231	5.662
1.089	1.176	1.333	1.610	2.033	2.598	3.460	4.474	5.517
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
8.331	6.097	4.869	4.094	3.676	3.433	3.356	3.532	5.347
6.145	5.211	4.396	3.885	3.551	3.342	3.285	3.468	5.234
4.755	4.244	3.872	3.537	3.302	3.162	3.145	3.342	5.011
3.768	3.510	3.317	3.166	3.047	2.949	2.959	3.176	4.687
3.014	2.880	2.785	2.747	2.677	2.668	2.742	2.993	4.453
2.357	2.343	2.313	2.310	2.307	2.355	2.452	2.708	3.156
1.896	1.899	1.905	1.925	1.966	2.052	2.173	2.460	3.166
1.425	1.438	1.464	1.514	1.576	1.701	1.838	2.153	2.741
1.075	1.097	1.140	1.212	1.319	1.472	1.690	1.994	2.411
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
8.948	6.650	5.150	4.246	3.768	3.483	3.376	3.522	5.270
6.702	6.270	5.254	4.341	3.854	3.525	3.376	3.469	5.110
5.038	5.105	4.880	4.227	3.845	3.510	3.339	3.365	4.871
3.919	3.964	4.005	3.919	3.647	3.404	3.245	3.259	4.550
3.101	3.174	3.319	3.342	3.261	3.162	3.076	3.162	4.380
2.405	2.517	2.649	2.757	2.800	2.822	2.817	2.936	3.349
1.918	1.992	2.100	2.216	2.318	2.438	2.567	2.743	3.460
1.430	1.476	1.560	1.666	1.828	2.033	2.266	2.535	3.059
1.064	1.096	1.188	1.327	1.561	1.850	2.229	2.753	2.421
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX					
9.913	7.434	5.433	4.398	3.840	3.534	3.397	3.512	5.234
7.492	10.039	7.165	5.588	4.472	3.976	3.573	3.550	5.087
5.323	7.549	10.617	8.140	5.829	4.567	3.949	3.723	4.993
4.070	5.231	7.991	11.765	9.019	6.294	4.847	4.209	5.051
3.139	3.792	5.350	8.963	13.313	10.606	7.379	5.516	5.710
2.452	2.855	3.713	5.775	10.587	17.735	13.764	9.169	7.354
1.940	2.182	2.712	3.919	6.394	14.357	25.973	20.678	12.710
1.435	1.576	1.938	2.760	4.708	9.863	23.738	46.635	37.600
1.052	1.176	1.490	2.250	4.047	6.694	22.001	60.462	129.127

TABLE B.6.4BRDF-ATMOSPHERE ANALYSIS FOR A PLANOPHILE GRASS CANOPY LAI=4.0
 WAVELENGTH = .80 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .222

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
18.166	17.644	17.369	17.350	17.277	17.073	16.985	17.755	25.048	
17.469	16.993	16.760	16.762	16.710	16.537	16.493	17.340	25.678	
16.285	15.871	15.671	15.690	15.663	15.536	15.568	16.549	25.003	
14.835	14.504	14.365	14.373	14.401	14.287	14.415	15.655	24.201	
12.663	12.484	12.449	12.370	12.399	12.492	13.056	14.943	25.512	
10.142	10.103	10.098	10.114	10.153	10.510	11.296	14.194	27.752	
7.701	7.651	7.659	7.798	7.966	8.540	10.181	15.619	38.583	
4.541	4.548	4.643	4.881	5.292	6.487	9.873	21.238	67.321	
1.431	1.508	1.699	2.098	3.031	5.404	12.541	37.138	129.683	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
18.194	17.676	17.402	17.373	17.294	17.087	16.992	17.749	25.004	
17.500	17.051	16.807	16.800	16.739	16.551	16.481	17.260	25.387	
16.317	15.916	15.714	15.725	15.681	15.523	15.488	16.286	24.083	
14.856	14.538	14.397	14.392	14.394	14.222	14.204	14.990	22.185	
12.677	12.507	12.464	12.364	12.344	12.317	12.541	13.544	20.931	
10.151	10.114	10.091	10.066	10.006	10.097	10.278	11.218	17.246	
7.705	7.647	7.618	7.678	7.631	7.746	8.050	8.987	14.163	
4.541	4.522	4.548	4.614	4.653	4.861	5.231	6.164	9.860	
1.424	1.452	1.503	1.622	1.798	2.026	2.496	3.387	5.768	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
18.227	17.712	17.435	17.396	17.312	17.100	16.999	17.743	25.960	
17.537	17.108	16.865	16.851	16.779	16.579	16.488	17.219	25.201	
16.349	15.973	15.780	15.784	15.727	15.552	15.481	16.187	23.707	
14.877	14.585	14.452	14.446	14.435	14.232	14.150	14.784	21.523	
12.692	12.539	12.503	12.402	12.358	12.294	12.432	13.212	19.908	
10.161	10.134	10.113	10.076	9.989	10.021	10.069	10.561	15.847	
7.709	7.653	7.617	7.650	7.562	7.584	7.680	8.214	12.299	
4.540	4.511	4.516	4.536	4.505	4.560	4.693	5.079	7.639	
1.418	1.419	1.428	1.473	1.532	1.587	1.736	2.092	3.407	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
18.273	17.755	17.468	17.421	17.331	17.114	17.006	17.737	25.916	
17.580	17.205	16.965	16.923	16.838	16.624	16.516	17.214	25.103	
16.381	16.070	15.907	15.893	15.830	15.634	15.538	16.197	23.538	
14.900	14.651	14.557	14.570	14.552	14.336	14.231	14.806	21.394	
12.707	12.590	12.593	12.509	12.476	12.405	12.520	13.254	19.799	
10.170	10.167	10.175	10.161	10.088	10.124	10.155	10.707	15.757	
7.714	7.671	7.655	7.707	7.630	7.560	7.759	8.253	12.222	
4.539	4.514	4.528	4.557	4.542	4.608	4.741	5.112	7.621	
1.411	1.406	1.418	1.469	1.545	1.618	1.769	2.133	3.601	
AZIMUTH = 159.00 DEGREES TOTAL RADIANCE MATRIX									
18.352	17.910	17.591	17.445	17.351	17.127	17.013	17.731	25.872	
17.635	17.487	17.164	17.071	16.939	16.701	16.573	17.246	25.075	
16.414	16.270	16.374	16.262	16.090	15.824	15.687	16.312	23.646	
14.922	14.793	14.923	15.263	15.106	14.750	14.549	15.081	21.630	
12.723	12.677	12.835	13.056	13.470	13.237	13.172	13.901	20.329	
10.180	10.224	10.331	10.535	10.902	11.620	11.494	11.339	16.872	
7.718	7.706	7.756	7.952	8.207	8.975	10.317	10.914	14.816	
4.538	4.531	4.592	4.728	4.950	5.622	7.336	10.372	14.993	
1.404	1.413	1.454	1.617	1.930	2.650	4.702	11.519	31.101	

TABLE B.6. PRODF-ATMOSPHERE ANALYSIS FOR A PLANOPILE GRASS CANOPY LAI=4.0
 WAVELENGTH = .30 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .361

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
17.597	16.893	16.476	16.319	16.094	15.702	15.345	15.702	24.423	
16.750	16.166	15.342	15.734	15.551	15.210	14.922	15.394	24.131	
15.520	15.047	14.794	14.716	14.578	14.308	14.136	14.308	23.608	
14.089	13.724	13.539	13.481	13.418	13.201	13.190	14.249	23.050	
12.001	11.900	11.732	11.614	11.590	11.629	12.154	14.008	24.748	
9.599	9.548	9.527	9.523	9.567	9.956	10.369	14.132	27.371	
7.295	7.238	7.254	7.413	7.666	8.419	10.569	17.247	40.474	
4.308	4.334	4.468	4.799	5.405	7.091	11.755	26.288	73.208	
1.417	1.532	1.814	2.383	3.735	7.168	17.136	48.919	143.359	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
17.659	16.956	16.537	16.357	16.119	15.719	15.351	15.690	24.373	
16.813	16.273	15.919	15.790	15.588	15.224	14.998	15.293	23.915	
15.580	15.123	14.847	14.760	14.595	14.290	14.018	14.457	22.613	
14.125	13.776	13.582	13.499	13.398	13.096	12.866	13.369	20.365	
12.023	11.832	11.747	11.598	11.499	11.366	11.423	12.157	19.743	
9.612	9.560	9.510	9.450	9.344	9.357	9.441	10.020	16.316	
7.290	7.229	7.188	7.209	7.165	7.051	7.523	9.365	13.483	
4.306	4.293	4.323	4.398	4.451	4.693	5.092	6.040	9.488	
1.406	1.448	1.521	1.676	1.906	2.210	2.784	3.730	5.704	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
17.729	17.032	16.598	16.395	16.144	15.736	15.357	15.679	24.323	
16.889	16.381	16.018	15.869	15.642	15.256	14.897	15.219	23.608	
15.640	15.221	14.955	14.846	14.654	14.309	13.991	14.315	22.000	
14.161	13.850	13.664	13.573	13.446	13.096	12.794	13.186	20.740	
12.045	11.877	11.800	11.643	11.507	11.316	11.583	11.711	18.632	
9.625	9.586	9.556	9.454	9.305	9.234	9.134	9.473	14.779	
7.296	7.233	7.181	7.179	7.053	7.007	6.893	7.342	11.432	
4.304	4.274	4.270	4.276	4.228	4.252	4.331	4.691	7.017	
1.396	1.399	1.411	1.457	1.513	1.579	1.726	2.045	3.177	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
17.825	17.124	16.659	16.435	16.171	15.752	15.363	15.667	24.273	
16.982	16.577	16.203	15.987	15.731	15.314	14.926	15.201	23.492	
15.700	15.404	15.182	15.025	14.808	14.419	14.055	14.307	22.054	
14.198	13.962	13.837	13.771	13.619	13.236	12.926	13.066	19.873	
12.069	11.958	11.942	11.806	11.677	11.466	11.553	11.732	18.485	
9.639	9.633	9.628	9.573	9.444	9.368	9.232	9.506	14.617	
7.301	7.257	7.232	7.256	7.144	7.103	7.095	7.363	11.133	
4.302	4.275	4.284	4.301	4.276	4.313	4.389	4.646	7.064	
1.336	1.381	1.398	1.454	1.544	1.636	1.820	2.204	3.477	
AZIMUTH = 150.00 DEGREES TOTAL RADIANCE MATRIX									
17.980	17.246	16.720	16.475	16.200	15.769	15.369	15.661	24.223	
17.104	17.171	16.821	16.660	16.394	15.924	15.495	15.723	23.449	
15.761	15.825	15.747	15.762	15.271	14.716	14.257	14.436	22.039	
14.235	14.230	14.577	15.168	14.693	13.949	13.366	13.457	20.000	
12.093	12.108	12.339	12.667	13.642	13.033	12.446	12.515	17.667	
9.652	9.704	9.891	10.255	11.104	10.279	10.709	10.329	14.671	
7.306	7.303	7.390	7.677	8.199	8.605	10.077	10.003	11.151	
4.300	4.299	4.382	4.554	4.994	5.192	6.031	5.014	6.461	
1.378	1.381	1.471	1.705	2.227	3.621	7.023	13.975	45.377	

TABLE B.6.6 BRDF-ATMOSPHERE ANALYSIS FOR A PLANCHILE GRASS CANOPY LAI=4.0
 WAVELENGTH = .80 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .689

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX								
17.018	15.707	14.917	14.497	14.054	13.478	12.985	13.449	23.727
15.617	14.706	14.179	13.891	13.541	13.052	12.656	13.249	23.453
14.170	13.539	13.155	12.957	12.690	12.305	12.064	12.875	22.969
12.721	12.276	12.014	11.865	11.704	11.423	11.406	12.662	22.479
10.769	10.522	10.405	10.242	10.174	10.207	10.823	12.906	24.342
8.584	8.508	8.467	8.461	8.534	9.053	10.248	14.034	27.795
6.509	6.465	6.500	6.708	7.124	8.179	11.029	19.786	41.192
3.880	3.937	4.141	4.638	5.566	7.993	14.266	31.339	75.865
1.412	1.591	2.026	2.876	4.886	9.951	23.308	61.015	151.691
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX								
17.197	15.873	15.066	14.579	14.100	13.505	12.992	13.433	23.675
15.783	14.970	14.346	13.995	13.601	13.068	12.617	13.109	23.129
14.319	13.706	13.277	13.031	12.711	12.257	11.890	12.438	21.948
12.801	12.377	12.087	11.891	11.668	11.261	10.976	11.567	20.231
10.813	10.579	10.427	10.212	10.029	9.812	9.796	10.600	19.167
8.609	8.527	8.437	8.336	8.186	8.142	8.213	9.071	15.793
6.516	6.449	6.395	6.416	6.547	6.432	6.733	7.614	13.017
3.878	3.873	3.911	4.007	4.094	4.404	4.856	5.823	9.116
1.399	1.462	1.571	1.782	2.093	2.496	3.171	4.058	5.564
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX								
17.397	16.079	15.214	14.658	14.147	13.531	12.999	13.417	23.623
15.990	15.233	14.568	14.153	13.696	13.116	12.612	13.026	22.916
14.469	13.928	13.504	13.192	12.807	12.297	11.849	12.256	21.525
12.881	12.532	12.245	12.022	11.744	11.254	10.841	11.211	19.492
10.857	10.671	10.521	10.288	10.036	9.734	9.353	10.042	18.030
8.633	8.574	8.481	8.341	8.125	7.956	7.732	8.151	14.230
6.527	6.459	6.385	6.338	6.176	6.070	5.994	6.350	10.933
3.876	3.845	3.831	3.820	3.757	3.756	3.605	4.065	6.858
1.385	1.391	1.408	1.457	1.522	1.594	1.736	2.003	2.952
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX								
17.659	16.340	15.362	14.742	14.197	13.557	13.006	13.401	23.571
16.253	15.757	15.019	14.403	13.863	13.213	12.651	13.000	22.795
14.617	14.380	14.041	13.571	13.106	12.484	11.941	12.242	21.372
12.964	12.780	12.622	12.434	12.072	11.497	10.979	11.209	19.323
10.905	10.831	10.813	10.612	10.352	9.993	9.708	10.079	17.804
8.658	8.666	8.661	8.580	8.384	8.193	7.946	8.212	14.119
6.537	6.503	6.482	6.484	6.347	6.251	6.167	6.431	10.985
3.874	3.853	3.866	3.877	3.865	3.897	3.956	4.198	6.741
1.372	1.373	1.411	1.490	1.624	1.770	2.000	2.400	3.528
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX								
18.049	16.698	15.511	14.826	14.248	13.584	13.013	13.385	23.519
16.613	17.392	16.172	15.062	14.204	13.403	12.755	13.030	22.740
14.766	15.547	16.643	15.506	14.171	13.073	12.232	12.420	21.410
13.046	13.445	14.589	16.092	14.779	13.069	11.993	11.750	19.395
10.953	11.170	11.894	13.385	15.359	13.806	12.010	11.440	18.670
8.683	8.952	9.249	10.203	12.349	13.360	13.574	11.764	16.231
6.546	6.604	6.619	7.423	9.838	12.427	17.697	16.105	16.932
3.872	3.902	4.070	4.494	5.495	8.273	13.421	26.801	26.499
1.358	1.409	1.590	2.038	3.107	5.925	13.828	35.936	70.822

TABLE B.7. 1BRDF-ATMOSPHERE ANALYSIS FOR A LODGEPOLE PINE CANOPY
 WAVELENGTH = .63 MICROMETERS. VISIBILITY = 13.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .259

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
2.962	2.798	2.505	2.500	2.619	2.924	3.504	4.659	8.994
2.503	2.306	2.359	2.279	2.426	2.829	3.284	4.538	8.735
2.136	1.985	1.859	2.058	2.095	2.432	3.102	4.547	9.435
1.759	1.686	1.693	1.809	2.041	2.457	3.268	5.151	11.055
1.450	1.408	1.442	1.581	1.829	2.336	3.410	5.836	13.689
1.173	1.161	1.221	1.399	1.724	2.450	3.890	7.716	20.350
.951	.985	1.086	1.326	1.817	2.779	5.170	12.082	36.476
.728	.788	.961	1.339	2.045	3.720	8.203	22.629	76.745
.624	.738	1.018	1.536	2.750	5.834	14.911	46.289	163.926
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
3.034	2.868	2.573	2.547	2.656	2.955	3.525	4.673	8.951
2.573	2.425	2.454	2.358	2.492	2.874	3.292	4.455	8.591
2.202	2.077	1.949	2.136	2.149	2.444	3.020	4.220	8.309
1.802	1.757	1.766	1.865	2.063	2.395	3.005	4.298	8.627
1.480	1.462	1.487	1.601	1.778	2.117	2.732	4.042	8.138
1.194	1.193	1.232	1.354	1.541	1.900	2.560	3.947	7.914
.963	.993	1.045	1.175	1.370	1.733	2.420	3.749	7.320
.732	.761	.940	.983	1.203	1.613	2.281	3.641	6.720
.618	.667	.760	.919	1.175	1.565	2.250	3.435	5.877
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
3.117	2.952	2.641	2.594	2.692	2.986	3.546	4.677	8.908
2.657	2.545	2.572	2.463	2.578	2.943	3.332	4.450	8.388
2.269	2.192	2.085	2.261	2.256	2.527	3.054	4.131	7.881
1.845	1.853	1.883	1.986	2.168	2.458	2.979	4.063	7.852
1.510	1.532	1.578	1.695	1.844	2.136	2.834	3.651	7.017
1.216	1.242	1.294	1.406	1.560	1.842	2.324	3.257	6.234
.978	1.017	1.070	1.166	1.310	1.551	1.960	2.773	5.143
.736	.753	.815	.899	1.027	1.235	1.594	2.272	4.063
.612	.631	.672	.736	.833	1.005	1.236	1.916	3.266
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
3.235	3.056	2.709	2.642	2.732	3.016	3.568	4.662	8.864
2.762	2.763	2.779	2.608	2.703	3.044	3.410	4.465	8.337
2.335	2.396	2.344	2.483	2.468	2.707	3.201	4.217	7.810
1.890	1.988	2.096	2.240	2.414	2.691	3.185	4.193	7.304
1.542	1.637	1.764	1.923	2.099	2.591	2.867	3.839	7.038
1.237	1.315	1.431	1.594	1.796	2.391	2.568	3.474	6.318
.988	1.064	1.163	1.306	1.486	1.750	2.202	2.997	5.293
.740	.780	.864	.977	1.151	1.399	1.793	2.501	4.318
.607	.627	.686	.773	.922	1.144	1.497	2.154	3.677
AZIMUTH = 179.00 DEGREES			TOTAL RADIANCE MATRIX					
3.437	3.195	2.778	2.692	2.773	3.047	3.589	4.666	8.82
2.901	3.479	3.249	2.914	2.905	3.204	3.538	4.539	8.330
2.403	2.867	3.482	3.312	3.003	3.091	3.514	4.433	8.010
1.935	2.283	2.920	3.874	3.636	3.536	3.330	4.770	8.337
1.575	1.814	2.264	3.131	4.408	4.205	4.195	4.940	8.104
1.259	1.434	1.747	2.363	3.667	5.535	5.460	5.750	8.454
1.001	1.143	1.374	1.806	2.670	4.611	3.942	8.434	10.254
.744	.826	1.017	1.333	1.975	3.460	3.326	15.256	19.261
.601	.656	.794	1.076	1.673	3.106	3.204	20.556	59.100

TABLE B.7.2BRDF-ATMOSPHERE ANALYSIS FOR A LODGEPOLE PINE CANOPY
 WAVELENGTH = .68 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .429

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
3.736	3.149	2.651	2.529	2.568	2.796	3.268	4.222	8.217
2.877	2.463	2.398	2.262	2.362	2.707	3.100	4.193	8.227
2.310	2.054	1.879	2.032	2.059	2.373	3.004	4.332	8.932
1.850	1.720	1.700	1.801	2.027	2.448	3.272	5.150	10.579
1.506	1.439	1.465	1.608	1.880	2.444	3.659	6.233	13.609
1.224	1.206	1.276	1.482	1.876	2.767	4.509	9.746	21.174
1.015	1.057	1.198	1.496	2.150	3.421	6.570	15.120	39.524
.823	.910	1.147	1.673	2.659	5.031	11.252	29.785	85.330
.762	.926	1.332	2.081	3.863	8.375	21.286	62.436	186.056
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
3.890	3.287	2.775	2.604	2.618	2.832	3.287	4.217	8.165
3.015	2.683	2.552	2.373	2.442	2.750	3.090	4.058	7.856
2.434	2.205	2.007	2.129	2.112	2.363	2.867	3.896	7.625
1.921	1.824	1.792	1.858	2.031	2.333	2.887	4.020	7.971
1.550	1.508	1.513	1.614	1.782	2.110	2.694	3.884	7.567
1.252	1.241	1.275	1.397	1.590	1.954	2.619	3.944	7.429
1.030	1.058	1.115	1.259	1.476	1.877	2.617	3.915	7.024
.826	.864	.959	1.133	1.394	1.888	2.637	4.019	6.475
.753	.820	.942	1.154	1.488	1.974	2.784	3.996	5.789
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
4.067	3.457	2.900	2.678	2.669	2.868	3.307	4.213	8.112
3.186	2.904	2.749	2.530	2.554	2.827	3.119	4.003	7.626
2.558	2.400	2.220	2.303	2.242	2.448	2.877	3.749	7.152
1.992	1.972	1.958	2.015	2.150	2.382	2.911	3.695	7.126
1.594	1.606	1.628	1.726	1.840	2.095	2.516	3.348	6.547
1.281	1.303	1.345	1.443	1.583	1.833	2.255	3.024	5.617
1.044	1.083	1.133	1.223	1.362	1.586	1.943	2.630	4.608
.829	.852	.908	.993	1.120	1.324	1.659	2.229	3.619
.745	.764	.809	.880	.991	1.165	1.441	1.906	2.732
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
4.312	3.674	3.025	2.756	2.724	2.904	3.327	4.209	8.059
3.403	3.338	3.129	2.762	2.731	2.951	3.198	4.016	7.515
2.691	2.777	2.681	2.656	2.549	2.676	3.032	3.805	7.031
2.066	2.194	2.302	2.409	2.498	2.677	3.033	3.788	7.012
1.642	1.763	1.911	2.056	2.189	2.415	2.769	3.502	6.289
1.309	1.403	1.537	1.703	1.882	2.139	2.521	3.214	5.618
1.059	1.141	1.252	1.401	1.580	1.835	2.219	2.937	4.682
.832	.874	.965	1.084	1.269	1.522	1.888	2.469	3.876
.734	.756	.825	.930	1.108	1.360	1.732	2.355	3.484
AZIMUTH = 159.00 DEGREES			TOTAL RADIANCE MATRIX					
4.717	3.972	3.151	2.834	2.780	2.941	3.346	4.205	8.007
3.703	4.832	4.092	3.321	3.051	3.168	3.645	4.098	7.505
2.806	3.747	5.003	4.287	3.483	3.257	3.436	4.086	7.172
2.140	2.745	3.942	5.670	4.826	4.102	3.967	4.478	7.485
1.691	2.060	2.820	4.397	6.703	5.777	4.932	4.993	7.384
1.338	1.583	2.059	3.081	5.278	8.747	7.740	6.745	8.161
1.073	1.250	1.573	2.233	3.700	7.209	13.159	12.195	11.440
.835	.934	1.172	1.646	2.677	5.240	12.134	25.327	25.668
.724	.791	.996	1.412	2.374	4.811	11.921	34.402	35.117

TABLE B.7.3800F-ATMOSPHERE ANALYSIS FOR A LODGEPOLE PINE CANOPY
 WAVELENGTH = .68 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .809

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX					
5.977	4.142	3.063	2.650	2.518	2.314	2.949	3.727	7.532
3.915	2.896	2.535	2.266	2.272	2.524	2.340	3.768	7.537
2.732	2.246	1.944	2.003	2.003	2.275	2.846	4.039	9.279
2.087	1.815	1.726	1.793	2.000	2.417	3.235	5.037	10.074
1.644	1.509	1.512	1.652	1.952	2.577	3.916	6.466	13.505
1.336	1.296	1.371	1.614	2.099	3.191	5.212	9.905	21.350
1.143	1.185	1.360	1.754	2.647	4.297	8.212	17.672	40.929
.999	1.123	1.453	2.202	3.577	6.631	14.869	36.001	89.933
1.014	1.251	1.845	2.937	5.521	11.875	28.968	77.262	199.942
AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
6.382	4.474	3.345	2.797	2.603	2.365	2.970	3.717	7.525
4.250	3.398	2.843	2.457	2.338	2.572	2.814	3.610	7.247
3.066	2.553	2.169	2.148	2.066	2.244	2.648	3.514	7.044
2.234	2.001	1.869	1.865	1.937	2.235	2.710	3.635	7.578
1.726	1.620	1.574	1.645	1.790	2.087	2.915	3.649	7.142
1.384	1.344	1.358	1.473	1.665	2.019	2.659	3.847	6.952
1.165	1.133	1.239	1.399	1.637	2.083	2.825	3.975	6.622
1.003	1.050	1.164	1.378	1.684	2.266	3.043	4.291	6.161
1.002	1.092	1.254	1.537	1.966	2.550	3.433	4.479	5.636
AZIMUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
6.841	4.895	3.627	2.945	2.687	2.715	2.991	3.707	7.469
4.672	3.399	3.253	2.744	2.666	2.673	2.837	3.532	7.006
3.350	2.963	2.585	2.444	2.255	2.346	2.639	3.323	6.553
2.381	2.295	2.161	2.115	2.152	2.260	2.584	3.292	6.550
1.808	1.791	1.756	1.807	1.855	2.042	2.354	2.993	5.790
1.431	1.441	1.460	1.529	1.636	1.826	2.156	2.744	5.700
1.137	1.220	1.261	1.333	1.456	1.644	1.924	2.443	4.775
1.009	1.032	1.035	1.165	1.279	1.463	1.741	2.153	3.243
.987	1.012	1.062	1.139	1.254	1.423	1.663	1.969	2.921
AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
7.457	5.449	3.908	3.097	2.779	2.766	3.011	3.697	7.412
5.250	4.958	4.111	3.200	2.959	2.856	2.929	3.532	6.832
3.633	3.825	3.593	3.135	2.797	2.693	2.633	3.365	6.414
2.531	2.739	2.949	2.866	2.752	2.735	2.667	3.265	6.392
1.895	2.085	2.290	2.402	2.438	2.536	2.639	3.162	5.711
1.479	1.615	1.796	1.976	2.129	2.293	2.521	2.972	5.093
1.209	1.313	1.456	1.624	1.806	2.030	2.319	2.726	4.249
1.014	1.070	1.131	1.317	1.531	1.796	2.119	2.536	3.557
.977	1.011	1.110	1.254	1.495	1.801	2.202	2.762	3.537
AZIMUTH = 150.00 DEGREES			TOTAL RADIANCE MATRIX					
8.423	6.232	4.192	3.249	2.871	2.817	3.032	3.637	7.333
6.019	5.727	4.522	4.447	3.487	3.203	3.016	3.616	6.859
3.919	4.268	4.330	4.048	3.782	3.751	3.443	3.763	6.507
2.682	4.006	4.935	4.713	3.824	3.625	3.470	4.312	6.894
1.983	2.793	4.321	4.923	4.290	4.290	4.251	5.516	7.044
1.526	1.954	2.865	4.992	4.916	4.916	4.916	6.226	6.593
1.231	1.503	2.068	3.327	4.332	4.349	4.349	5.723	6.492
1.019	1.170	1.533	2.411	3.411	3.411	3.411	4.633	5.611
.965	1.092	1.411	2.177	3.282	3.282	3.282	4.461	5.636

TABLE B.7.4 BRDF-ATMOSPHERE ANALYSIS FOR A LODGEPOLE PINE CANOPY
 WAVELENGTH = .80 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .222

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
10.624	11.304	11.420	12.028	13.280	15.474	19.116	26.683	59.516	
10.006	10.173	10.628	11.423	12.538	14.754	17.942	25.122	56.026	
8.658	8.647	8.725	9.922	10.721	12.692	16.194	23.337	53.480	
7.591	7.623	8.097	9.092	10.167	12.312	15.782	23.081	53.682	
6.079	6.322	6.858	7.653	8.565	10.286	13.623	20.590	49.357	
4.784	4.959	5.379	5.959	6.872	8.596	11.818	19.148	48.654	
3.481	3.615	4.051	4.551	5.309	6.960	10.298	18.379	53.110	
1.857	1.958	2.354	2.883	3.654	5.512	9.943	23.322	76.568	
.766	.863	1.133	1.620	2.612	5.215	12.642	37.792	132.347	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
10.652	11.336	11.453	12.051	13.297	15.488	19.122	26.682	59.472	
10.037	10.231	10.675	11.460	12.567	14.768	17.930	25.043	55.736	
8.690	8.692	8.767	9.956	10.738	12.659	16.114	23.073	52.561	
7.612	7.657	8.129	9.110	10.161	12.247	15.571	22.415	51.666	
6.093	6.346	6.873	7.648	8.510	10.111	13.109	19.191	44.776	
4.793	4.970	5.372	5.911	6.725	8.182	10.800	16.172	38.148	
3.486	3.611	4.011	4.431	4.974	6.165	8.157	12.247	28.390	
1.856	1.932	2.259	2.617	3.015	3.885	5.301	8.248	19.107	
.759	.807	.937	1.144	1.380	1.838	2.598	4.040	8.432	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
10.684	11.373	11.486	12.074	13.314	15.501	19.129	26.676	59.428	
10.074	10.288	10.733	11.512	12.606	14.796	17.937	25.002	55.550	
8.722	8.749	8.834	10.015	10.785	12.709	16.107	22.974	52.185	
7.633	7.704	8.184	9.164	10.201	12.257	15.516	22.210	51.005	
6.107	6.378	6.913	7.685	8.524	10.088	12.999	19.860	43.754	
4.803	4.990	5.394	5.921	6.708	8.107	10.591	15.615	36.749	
3.490	3.617	4.010	4.403	4.905	6.004	7.787	11.474	26.313	
1.855	1.920	2.226	2.538	2.867	3.585	4.763	7.164	16.395	
.752	.773	.862	.996	1.114	1.399	1.938	2.745	6.071	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
10.730	11.416	11.518	12.098	13.334	15.514	19.136	26.671	59.384	
10.117	10.386	10.833	11.584	12.666	14.841	17.966	24.997	55.451	
8.754	8.846	8.960	10.125	10.887	12.791	16.164	22.984	52.066	
7.655	7.771	8.289	9.289	10.318	12.361	15.598	22.231	50.875	
6.123	6.428	7.002	7.793	8.642	10.199	13.087	18.901	43.645	
4.812	5.023	5.457	6.006	6.807	8.210	10.677	15.661	36.659	
3.494	3.635	4.048	4.460	4.974	6.080	7.866	11.513	26.749	
1.855	1.923	2.238	2.559	2.904	3.632	4.811	7.176	16.868	
.745	.761	.852	.992	1.126	1.429	1.890	2.837	6.265	
AZIMUTH = 159.00 DEGREES TOTAL RADIANCE MATRIX									
10.809	11.471	11.552	12.123	13.353	15.529	19.143	26.665	59.341	
10.172	10.667	11.032	11.731	12.767	14.918	18.022	25.029	55.424	
8.787	9.047	9.428	10.493	11.148	12.981	16.313	23.100	52.123	
7.677	7.912	8.655	9.952	10.873	12.775	15.916	22.506	51.112	
6.139	6.516	7.245	8.340	9.637	11.031	13.739	19.448	44.174	
4.822	5.080	5.612	6.380	7.622	8.705	12.017	16.792	37.774	
3.499	3.670	4.149	4.705	5.550	7.395	10.424	14.074	29.343	
1.854	1.941	2.302	2.730	3.312	4.646	7.407	12.457	24.239	
.739	.768	.898	1.139	1.512	2.461	4.874	12.173	33.751	

TABLE B.7.5BRDF-ATMOSPHERE ANALYSIS FOR A LODGEPOLE PINE CANOPY
 WAVELENGTH = .80 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .361

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX									
10.463	10.905	10.874	11.334	12.379	14.233	17.258	23.513	57.114	
9.694	9.727	10.071	10.735	11.675	13.574	16.230	22.281	53.722	
8.313	8.232	8.253	9.319	9.991	11.700	14.701	20.911	51.364	
7.249	7.238	7.649	8.542	9.491	11.390	14.422	20.817	51.858	
5.794	6.000	6.486	7.210	8.039	9.609	12.665	18.997	48.039	
4.560	4.717	5.108	5.657	6.534	8.217	11.358	18.549	48.263	
3.332	3.462	3.898	4.379	5.220	6.981	10.665	20.109	54.591	
1.818	1.934	2.353	2.963	3.911	6.212	11.818	28.102	82.114	
.823	.957	1.311	1.961	3.368	7.005	17.223	49.466	146.329	
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX									
10.525	10.968	10.936	11.372	12.404	14.250	17.274	23.602	57.064	
9.756	9.835	10.148	10.790	11.712	13.587	16.205	22.171	53.406	
8.373	8.308	8.316	9.363	10.007	11.672	14.580	20.460	50.368	
7.284	7.290	7.691	8.561	9.471	11.285	14.117	19.937	49.671	
5.816	6.032	6.501	7.193	7.948	9.347	11.933	17.146	43.033	
4.573	4.728	5.091	5.579	6.311	7.608	9.910	14.587	36.708	
3.337	3.453	3.823	4.215	4.718	5.813	7.619	11.223	27.579	
1.816	1.893	2.208	2.561	2.957	3.814	5.155	7.853	18.394	
.813	.873	1.018	1.253	1.539	2.046	2.871	4.277	6.194	
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX									
10.595	11.044	10.997	11.410	12.429	14.267	17.280	23.590	57.014	
9.832	9.942	10.247	10.869	11.766	13.619	16.204	22.107	53.199	
8.434	8.406	8.424	9.449	10.066	11.702	14.555	20.317	49.956	
7.320	7.364	7.773	8.634	9.519	11.285	14.025	19.654	48.949	
5.837	6.079	6.553	7.239	7.955	9.298	11.763	16.698	41.924	
4.586	4.754	5.117	5.593	6.273	7.486	9.603	13.345	35.191	
3.342	3.457	3.816	4.205	4.607	5.561	7.039	10.205	23.560	
1.814	1.874	2.155	2.440	2.734	3.373	4.393	6.425	10.838	
.802	.824	.908	1.035	1.151	1.416	1.813	2.592	3.924	
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX									
10.691	11.136	11.057	11.449	12.456	14.284	17.286	23.597	56.964	
9.925	10.138	10.432	10.987	11.855	13.677	16.233	22.089	53.063	
8.493	8.589	8.651	9.629	10.221	11.811	14.617	20.310	49.809	
7.357	7.477	7.947	8.833	9.691	11.425	14.118	19.654	48.785	
5.861	6.158	6.695	7.402	8.125	9.446	11.863	16.721	41.776	
4.599	4.802	5.209	5.707	6.411	7.620	9.701	13.875	35.065	
3.347	3.481	3.867	4.242	4.697	5.665	7.180	10.231	25.472	
1.812	1.875	2.169	2.465	2.782	3.433	4.451	6.458	10.869	
.792	.806	.895	1.032	1.176	1.472	1.906	2.750	3.924	
AZIMUTH = 159.00 DEGREES TOTAL RADIANCE MATRIX									
10.846	11.258	11.118	11.459	12.485	14.300	17.292	23.567	56.914	
10.048	10.732	10.350	11.260	12.018	13.787	16.303	22.115	53.040	
8.554	9.010	9.616	10.365	10.684	12.108	14.822	20.439	49.845	
7.395	7.744	8.667	10.229	10.765	12.138	14.598	20.095	49.011	
5.886	6.308	7.142	8.479	10.090	11.019	12.957	17.504	42.361	
4.613	4.892	5.473	6.389	7.992	10.531	12.177	15.876	36.468	
3.352	3.522	4.027	4.660	5.753	8.197	12.070	14.788	29.113	
1.809	1.899	2.267	2.748	3.500	5.310	9.392	17.027	27.836	
.782	.817	.970	1.293	1.660	3.055	7.414	15.522	45.045	

TABLE B.7.6 BRDF-ATMOSPHERE ANALYSIS FOR A LODGEPOLE PINE CANOPY
 WAVELENGTH = .80 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .689

AZIMUTH = 1.00 DEGREES TOTAL RADIANCE MATRIX								
10.660	10.382	9.963	10.122	10.830	12.221	14.614	20.327	58.907
9.332	8.987	9.079	9.507	10.179	11.651	13.762	19.228	55.155
7.763	7.498	7.396	8.232	8.720	10.079	12.540	18.077	52.677
6.650	6.536	6.827	7.548	8.308	9.878	12.446	18.357	53.526
5.279	5.406	5.798	6.405	7.114	8.490	11.252	17.220	49.422
4.151	4.268	4.607	5.107	5.935	7.574	10.640	17.793	49.703
3.060	3.179	3.585	4.117	5.045	6.973	11.108	21.228	56.222
1.754	1.894	2.348	3.093	4.324	7.272	14.317	32.854	85.163
.945	1.139	1.632	2.548	4.604	9.727	23.373	61.437	154.077
AZIMUTH = 60.00 DEGREES TOTAL RADIANCE MATRIX								
10.839	10.548	10.112	10.203	10.876	12.247	14.621	20.312	58.855
9.498	9.251	9.246	9.611	10.239	11.667	13.723	19.089	54.331
7.912	7.665	7.518	8.307	8.741	10.031	12.366	17.640	51.656
6.730	6.637	6.900	7.574	8.272	9.716	12.016	17.262	51.278
5.324	5.463	5.820	6.375	6.969	8.095	10.226	14.913	44.247
4.175	4.286	4.578	4.981	5.587	6.663	8.606	12.829	37.690
3.069	3.164	3.480	3.826	4.269	5.226	6.813	10.056	28.047
1.752	1.830	2.118	2.462	2.851	3.682	4.907	7.338	18.416
.931	1.011	1.178	1.454	1.811	2.372	3.236	4.480	7.950
AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX								
11.039	10.754	10.260	10.284	10.922	12.273	14.628	20.296	58.803
9.705	9.514	9.468	9.768	10.335	11.715	13.718	19.005	54.618
8.061	7.886	7.745	8.467	8.838	10.071	12.326	17.458	51.233
6.810	6.792	7.058	7.705	8.348	9.709	11.881	16.906	50.539
5.368	5.554	5.914	6.451	6.976	8.018	9.982	14.356	43.110
4.200	4.334	4.621	4.987	5.526	6.477	8.174	11.909	36.138
3.079	3.173	3.470	3.748	4.097	4.864	6.074	8.792	25.968
1.750	1.801	2.039	2.275	2.515	3.034	3.856	5.579	17.356
.917	.939	1.015	1.129	1.240	1.470	1.800	2.425	5.438
AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX								
11.301	11.015	10.408	10.367	10.973	12.300	14.635	20.280	58.751
9.968	10.038	9.919	10.019	10.501	11.812	13.758	18.979	54.497
8.209	8.339	8.282	8.847	9.136	10.258	12.417	17.444	51.080
6.892	7.040	7.435	8.117	8.676	9.952	12.013	16.903	50.370
5.416	5.715	6.206	6.775	7.292	8.277	10.138	14.391	42.964
4.225	4.426	4.801	5.225	5.785	6.714	8.338	11.970	36.026
3.088	3.217	3.567	3.893	4.268	5.045	6.246	8.874	25.915
1.748	1.810	2.073	2.334	2.622	3.175	4.007	5.713	16.039
.904	.921	1.017	1.162	1.342	1.646	2.065	2.822	5.914
AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX								
11.691	11.373	10.557	10.451	11.024	12.326	14.642	20.264	58.699
10.328	11.673	11.070	10.677	10.843	12.007	13.862	19.009	54.451
8.358	9.506	10.384	10.781	10.201	10.847	12.758	17.622	51.118
6.975	7.705	9.401	11.775	11.384	11.523	12.923	17.445	50.643
5.464	6.053	7.287	9.547	12.299	12.089	12.439	15.753	43.750
4.250	4.612	5.389	6.348	9.751	13.902	14.046	15.622	38.139
3.097	3.318	3.904	4.837	6.760	11.221	17.776	18.547	30.012
1.746	1.958	2.278	2.749	4.252	7.551	15.470	28.316	35.797
.690	.957	1.186	1.710	2.346	5.901	13.932	36.408	75.205

TABLE 8.1 BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIESEL, 1977).
 WAVELENGTH = .606 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .302

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
4.583	4.166	3.895	3.652	3.535	3.498	3.424	3.365	4.692	
3.729	3.466	3.370	3.192	3.128	3.190	3.282	3.733	5.215	
3.126	2.876	2.839	2.833	2.787	2.923	3.227	4.079	6.316	
2.629	2.379	2.349	2.460	2.587	2.796	3.375	4.381	6.410	
2.241	1.997	1.950	2.192	2.519	2.919	3.941	5.293	12.421	
1.898	1.708	1.694	1.977	2.523	3.339	5.026	9.152	20.566	
1.550	1.467	1.552	1.921	2.729	4.042	6.984	14.742	38.308	
1.267	1.323	1.510	2.026	3.111	5.320	10.734	26.901	82.673	
1.084	1.237	1.586	2.268	3.808	7.478	17.791	52.367	182.859	

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIESEL, 1977).
 WAVELENGTH = .606 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .499

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
5.859	4.688	4.067	3.655	3.434	3.325	3.212	3.332	3.496	
4.290	3.673	3.401	3.135	3.020	3.043	3.108	3.477	4.560	
3.370	2.954	2.820	2.765	2.704	2.830	3.136	3.925	5.775	
2.736	2.406	2.332	2.418	2.544	2.782	3.413	4.950	7.956	
2.286	2.015	1.959	2.192	2.538	3.018	4.207	6.735	12.308	
1.930	1.741	1.741	2.048	2.553	3.351	5.372	10.423	20.471	
1.601	1.534	1.657	2.097	3.065	4.718	6.483	17.447	42.215	
1.356	1.444	1.707	2.339	3.783	6.759	14.105	34.607	92.351	
1.230	1.440	1.931	2.889	5.086	10.399	25.035	70.492	211.571	

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIESEL, 1977).
 WAVELENGTH = .606 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .927

AZIMUTH = 1.00 DEGREES			TOTAL RADIANCE MATRIX						
9.255	6.064	4.564	3.756	3.321	3.089	2.905	2.432	3.435	
5.740	4.227	3.547	3.086	2.867	2.828	2.956	3.134	4.115	
3.997	3.176	2.832	2.672	2.578	2.681	2.872	3.665	6.051	
3.016	2.496	2.321	2.355	2.469	2.733	3.388	4.348	7.491	
2.414	2.066	1.981	2.137	2.549	3.112	4.429	6.811	12.275	
2.010	1.806	1.817	2.146	2.619	4.015	6.301	11.253	21.302	
1.704	1.648	1.820	2.350	3.517	5.347	10.046	20.317	44.187	
1.514	1.642	2.012	2.920	4.706	8.592	17.734	40.742	92.023	
1.487	1.773	2.468	3.810	6.880	14.178	33.220	86.250	231.121	

Table B.8.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
OPTICAL DEPTH = .302

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
4.775	4.332	4.006	3.771	3.554	3.551	3.501	3.683	4.602
3.936	3.788	3.528	3.325	3.204	3.238	3.354	3.620	4.711
3.353	3.187	3.029	2.893	2.815	2.896	3.215	3.654	4.891
2.806	2.747	2.618	2.497	2.478	2.646	3.186	3.863	5.397
2.412	2.364	2.218	2.158	2.190	2.492	3.123	4.019	5.902
2.033	1.963	1.850	1.846	2.027	2.469	3.140	4.287	6.418
1.626	1.613	1.565	1.638	1.934	2.473	3.303	4.533	7.122
1.277	1.318	1.363	1.515	1.844	2.454	3.339	4.819	7.516
1.078	1.153	1.275	1.496	1.872	2.432	3.348	4.829	7.468

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
OPTICAL DEPTH = .499

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
6.213	4.964	4.269	3.815	3.479	3.386	3.272	3.338	3.896
4.604	4.144	3.650	3.318	3.121	3.093	3.151	3.318	4.032
3.678	3.342	3.067	2.861	2.741	2.785	3.048	3.394	4.238
2.948	2.803	2.617	2.466	2.432	2.579	3.063	3.648	4.764
2.470	2.381	2.215	2.150	2.183	2.473	3.064	3.868	5.301
2.067	1.984	1.871	1.878	2.064	2.496	3.169	4.256	5.855
1.676	1.661	1.626	1.720	2.030	2.589	3.450	4.523	6.609
1.365	1.414	1.481	1.669	2.034	2.711	3.642	5.095	7.052
1.221	1.314	1.468	1.744	2.195	2.841	3.863	5.292	7.124

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
OPTICAL DEPTH = .927

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
10.059	6.630	4.993	4.012	3.421	3.170	2.969	2.930	3.333
6.340	5.089	4.013	3.382	3.025	2.891	2.872	2.943	3.484
4.522	3.766	3.212	2.849	2.640	2.621	2.806	3.051	3.703
3.323	2.976	2.658	2.437	2.367	2.471	2.870	3.338	4.233
2.634	2.453	2.232	2.148	2.169	2.424	2.940	3.607	4.783
2.160	2.041	1.913	1.929	2.109	2.512	3.143	4.088	5.354
1.782	1.755	1.728	1.845	2.159	2.716	3.554	4.553	6.133
1.528	1.580	1.671	1.902	2.296	3.025	3.928	5.189	6.623
1.476	1.589	1.784	2.127	2.661	3.375	4.428	5.612	6.777

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Table B.8.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .302

AZINUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
4.996	4.571	4.204	3.934	3.781	3.644	3.578	3.766	4.587
4.215	4.198	4.014	3.913	3.791	3.632	3.509	3.747	4.597
3.581	3.652	3.646	3.604	3.565	3.449	3.372	3.704	4.608
3.091	3.086	3.167	3.294	3.141	3.072	3.141	3.657	4.648
2.584	2.575	2.676	2.864	2.701	2.708	3.101	3.764	4.749
2.070	2.124	2.181	2.214	2.282	2.463	3.033	3.713	4.668
1.632	1.716	1.832	1.862	1.994	2.294	2.753	3.388	4.455
1.278	1.388	1.509	1.548	1.704	1.992	2.416	3.169	4.526
1.071	1.124	1.197	1.291	1.476	1.762	2.180	2.926	4.304

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .499

AZINUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX						
6.623	5.343	4.549	4.013	3.710	3.483	3.342	3.399	3.867	
5.020	4.697	4.235	3.947	3.702	3.466	3.281	3.385	3.877	
3.987	3.909	3.770	3.600	3.466	3.293	3.163	3.354	3.891	
3.259	3.207	3.211	3.262	3.068	2.953	2.963	3.321	3.933	
2.653	2.628	2.685	2.830	2.646	2.630	2.937	3.421	4.034	
2.115	2.158	2.197	2.216	2.268	2.414	2.691	3.396	3.967	
1.687	1.762	1.866	1.891	2.013	2.250	2.663	3.147	3.781	
1.366	1.468	1.581	1.622	1.769	2.036	2.411	2.998	3.869	
1.211	1.261	1.336	1.434	1.616	1.988	2.270	2.874	3.736	

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .927

AZINUTH = 90.00 DEGREES			TOTAL RADIANCE MATRIX					
10.992	7.387	5.488	4.301	3.674	3.280	3.034	2.975	3.296
7.132	6.023	4.860	4.135	3.630	3.254	2.984	2.966	3.307
5.046	4.603	4.148	3.686	3.360	3.090	2.887	2.945	3.322
3.711	3.550	3.381	3.275	2.992	2.796	2.723	2.926	3.365
2.854	2.791	2.753	2.820	2.586	2.528	2.715	3.021	3.464
2.236	2.257	2.259	2.246	2.265	2.347	2.695	3.022	3.409
1.807	1.867	1.946	1.955	2.054	2.261	2.530	2.847	3.249
1.535	1.620	1.716	1.757	1.880	2.102	2.389	2.777	3.349
1.465	1.511	1.583	1.682	1.850	2.087	2.392	2.801	3.283

Table B.8.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .302

OPTICAL DEPTH = 0.502			TOTAL RADIANCE MATRIX						
AZIMUTH = 120.00 DEGREES									
5.257	4.767	4.317	4.057	3.849	3.737	3.656	3.916	4.572	
4.411	4.628	4.355	4.193	4.001	3.882	3.931	3.926	4.588	
3.692	4.027	4.111	4.087	3.995	3.936	3.904	4.034	4.665	
3.129	3.237	3.307	3.614	3.691	3.795	3.871	4.084	4.783	
2.579	2.660	2.747	3.068	3.309	3.455	3.703	4.112	4.892	
2.108	2.201	2.344	2.562	2.836	3.080	3.522	4.147	5.030	
1.691	1.784	1.929	2.078	2.327	2.726	3.252	4.047	5.145	
1.258	1.303	1.499	1.683	1.846	2.172	2.701	3.538	5.011	
1.057	1.101	1.218	1.385	1.637	2.005	2.555	3.508	5.339	

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .499

AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
7.164	5.741	4.752	4.176	3.801	3.580	3.411	3.433	3.837
5.419	5.490	4.852	4.358	3.992	3.742	3.579	3.520	3.823
4.188	4.558	4.549	4.275	4.034	3.831	3.670	3.617	3.870
3.345	3.502	3.576	3.808	3.759	3.732	3.666	3.668	3.962
2.677	2.804	2.930	3.213	3.379	3.441	3.543	3.720	4.054
2.163	2.283	2.452	2.672	2.918	3.097	3.408	3.788	4.189
1.746	1.851	2.013	2.173	2.414	2.771	3.200	3.752	4.326
1.349	1.402	1.598	1.786	1.970	2.295	2.766	3.405	4.286
1.194	1.241	1.369	1.552	1.836	2.228	2.775	3.621	4.870

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .927

AZIMUTH = 120.00 DEGREES			TOTAL RADIANCE MATRIX					
12.277	8.327	5.919	4.563	3.816	3.389	3.098	2.996	3.258
8.078	7.770	6.171	4.859	4.098	3.597	3.269	3.069	3.229
5.481	5.953	5.711	4.824	4.248	3.761	3.399	3.166	3.262
3.913	4.187	4.270	4.346	4.017	3.739	3.447	3.231	3.343
2.944	3.177	3.394	3.607	3.619	3.525	3.396	3.327	3.441
2.312	2.494	2.731	2.965	3.161	3.222	3.336	3.453	3.593
1.872	2.011	2.216	2.405	2.640	2.934	3.226	3.513	3.774
1.527	1.602	1.813	2.016	2.246	2.576	2.968	3.375	3.859
1.449	1.510	1.668	1.890	2.241	2.676	3.217	3.917	4.704

Table B.8.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .302
 AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX

5.799	5.128	4.476	4.180	4.000	3.830	3.733	3.866	4.557
4.770	6.318	5.352	4.862	4.574	4.265	4.123	4.195	4.791
3.884	5.058	6.639	5.946	5.326	4.786	4.595	4.698	5.231
3.203	4.007	5.301	7.504	6.440	5.475	5.050	5.166	5.812
2.604	3.073	4.022	5.835	5.549	7.350	6.387	6.253	6.929
2.096	2.377	3.058	4.301	6.738	10.771	9.370	8.541	9.042
1.679	1.955	2.458	3.192	4.763	8.206	14.382	13.710	13.298
1.278	1.440	1.736	2.189	3.218	5.675	12.291	27.707	28.669
1.058	1.162	1.392	1.845	2.800	5.037	11.221	32.450	97.562

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .499
 AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX

8.202	6.391	4.999	4.340	3.968	3.676	3.481	3.466	3.308
6.070	8.816	6.710	5.413	4.722	4.199	3.988	3.753	3.967
4.466	6.458	9.421	7.469	5.943	4.955	4.470	4.259	4.326
3.464	4.656	6.918	10.771	8.302	6.273	5.256	4.878	4.869
2.730	3.394	4.810	7.827	12.709	9.805	7.420	6.361	6.069
2.168	2.557	3.470	5.320	9.415	16.541	12.894	9.891	8.659
1.741	2.066	2.696	3.768	6.244	12.293	24.012	19.417	14.832
1.368	1.555	1.936	2.617	4.216	8.277	19.741	44.722	37.992
1.191	1.320	1.626	2.281	3.747	7.370	17.716	51.977	136.556

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .927
 AZIMUTH = 179.00 DEGREES TOTAL RADIANCE MATRIX

14.578	9.782	6.389	4.826	4.021	3.499	3.163	3.017	3.221
9.542	15.447	10.326	6.984	5.209	4.220	3.629	3.292	3.340
5.983	10.187	16.727	11.490	7.584	5.509	4.445	3.841	3.666
4.143	6.340	11.174	19.222	13.085	8.296	5.915	4.741	4.252
3.058	4.208	6.823	12.972	23.159	15.843	9.915	7.011	5.695
2.350	3.000	4.498	7.874	16.115	30.390	20.989	13.005	9.172
1.884	2.336	3.283	5.174	9.824	21.946	44.160	30.931	18.522
1.548	1.806	2.393	3.600	6.504	14.126	35.645	77.078	53.779
1.443	1.642	2.120	3.211	5.738	12.115	30.070	84.582	190.277

TABLE B.8.2 BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .209
 AZIMUTH = 0.00 DEGREES TOTAL RADIANCE MATRIX

11.035	11.072	10.854	10.624	10.517	10.328	9.954	9.356	8.152
10.765	10.709	10.255	9.971	9.836	9.632	9.513	9.165	8.449
10.256	10.100	9.339	8.672	8.550	8.688	8.947	8.909	8.679
9.272	8.939	8.043	7.462	7.405	7.736	8.331	8.730	9.344
7.761	7.313	6.597	6.542	6.813	7.120	7.846	8.900	11.503
5.827	5.479	5.297	5.505	6.051	6.731	7.721	9.834	16.689
3.887	3.925	4.109	4.414	4.994	5.968	7.617	12.125	28.870
2.196	2.345	2.538	2.943	3.671	5.153	8.223	18.041	56.387
.959	1.094	1.320	1.742	2.669	4.912	11.162	32.096	109.593

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .336
 AZIMUTH = 0.00 DEGREES TOTAL RADIANCE MATRIX

10.769	10.666	10.355	10.050	9.856	9.565	9.070	8.360	7.581
10.387	10.243	9.745	9.412	9.210	8.926	8.690	8.242	7.914
9.826	9.623	8.956	8.182	8.014	8.072	8.219	8.113	8.243
8.850	8.501	7.624	7.047	6.959	7.228	7.741	9.150	9.065
7.394	6.951	6.260	6.193	6.435	6.725	7.460	8.637	11.517
5.551	5.216	5.042	5.243	5.773	6.494	7.619	10.180	17.319
3.714	3.754	3.942	4.265	4.901	6.011	8.102	13.749	30.390
2.124	2.282	2.505	2.979	3.853	5.723	9.875	22.417	61.608
.975	1.137	1.433	1.994	3.263	6.379	14.993	41.900	121.266

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .645
 AZIMUTH = 0.00 DEGREES TOTAL RADIANCE MATRIX

10.616	10.045	9.469	9.003	8.671	8.268	7.723	7.172	7.171
9.818	9.407	8.793	8.372	8.078	7.719	7.430	7.134	7.517
9.060	8.724	7.940	7.263	7.039	7.015	7.100	7.145	7.888
8.057	7.659	6.820	6.264	6.147	6.354	6.825	7.422	9.776
6.691	6.251	5.611	5.533	5.742	6.038	6.845	8.261	11.355
5.018	4.705	4.550	4.745	5.272	6.069	7.420	10.474	17.435
3.382	3.423	3.619	3.977	4.717	6.053	8.760	15.449	31.652
1.992	2.163	2.439	3.038	4.158	6.630	12.219	27.128	63.928
1.022	1.228	1.646	2.446	4.277	8.711	20.386	52.575	127.517

Table B.8.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .866 MICROMETERS. VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM

OPTICAL DEPTH = .209

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
11.053	11.094	10.877	10.668	10.582	10.363	9.982	9.304	8.094
10.599	10.483	10.209	10.024	10.088	9.840	9.356	8.793	7.883
9.877	9.581	9.220	8.793	8.945	8.977	8.562	8.016	7.300
8.720	8.176	7.840	7.671	7.916	8.034	7.844	7.362	6.771
7.148	6.340	6.182	6.704	7.004	7.038	7.180	6.996	6.660
5.394	4.736	4.977	5.614	5.847	5.965	6.420	6.621	6.632
3.638	3.498	3.925	4.331	4.597	4.884	5.392	5.801	6.376
2.181	2.389	2.476	2.588	3.007	3.424	3.858	4.756	6.065
.969	1.100	1.174	1.299	1.578	1.916	2.428	3.326	4.764

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .866 MICROMETERS. VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM

OPTICAL DEPTH = .336

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
10.809	10.709	10.398	10.103	9.924	9.600	9.095	8.308	7.519
10.252	10.066	9.726	9.476	9.452	9.116	8.535	7.879	7.346
9.488	9.156	8.761	8.305	8.381	8.323	7.829	7.223	6.834
8.339	7.812	7.442	7.243	7.422	7.464	7.203	6.691	6.386
6.820	6.039	5.869	6.334	6.579	6.563	6.632	6.420	6.336
5.145	4.516	4.732	5.316	5.514	5.598	5.991	6.130	6.365
3.481	3.348	3.746	4.126	4.373	4.644	5.133	5.547	6.199
2.109	2.309	2.399	2.522	2.933	3.369	3.831	4.754	5.962
.980	1.113	1.204	1.357	1.668	2.053	2.642	3.577	4.794

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .866 MICROMETERS. VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM

OPTICAL DEPTH = .645

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
10.738	10.164	9.577	9.086	8.749	8.307	7.745	7.123	7.108	
9.778	9.374	8.852	8.471	8.310	7.884	7.283	6.795	6.954	
8.829	8.385	7.907	7.397	7.360	7.206	6.707	6.266	6.477	
7.638	7.091	6.687	6.442	6.527	6.488	6.217	5.875	6.069	
6.200	5.468	5.274	5.640	5.805	5.747	5.784	5.708	6.046	
4.671	4.097	4.265	4.756	4.907	4.964	5.321	5.620	6.099	
3.183	3.062	3.405	3.740	3.962	4.226	4.716	5.197	5.975	
1.978	2.159	2.255	2.398	2.794	3.263	3.762	4.691	5.772	
1.021	1.154	1.273	1.471	1.831	2.279	2.944	3.924	4.710	

Table B.8.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .209

AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX

11.047	11.064	10.928	10.739	10.755	10.579	10.207	9.407	7.904
10.490	10.390	10.384	10.218	10.347	10.335	10.047	9.094	7.552
9.674	9.372	9.467	9.376	9.509	9.676	9.597	8.544	7.048
8.599	8.229	8.216	8.218	8.443	8.670	8.594	7.572	6.340
7.197	6.750	6.844	6.994	7.195	7.283	7.076	6.482	5.716
5.589	5.123	5.301	5.646	5.748	5.716	5.714	5.843	5.568
3.915	3.738	3.659	3.853	4.113	4.341	4.638	5.119	5.141
2.234	2.295	2.188	2.229	2.441	2.867	3.398	3.849	4.072
.950	1.024	1.075	1.146	1.269	1.489	1.900	2.191	2.599

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .336

AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX

10.830	10.709	10.467	10.182	10.091	9.803	9.297	8.393	7.334
10.177	10.016	9.923	9.682	9.707	9.576	9.153	8.119	7.009
9.316	8.990	9.027	8.874	8.917	8.966	8.747	7.637	6.542
8.236	7.866	7.817	7.772	7.919	8.038	7.941	6.785	5.887
6.872	6.438	6.503	6.613	6.750	6.763	6.476	5.831	5.311
5.332	4.886	5.039	5.340	5.402	5.323	5.252	5.276	5.176
3.741	3.572	3.491	3.660	3.883	4.065	4.286	4.648	4.781
2.157	2.213	2.112	2.148	2.339	2.720	3.179	3.540	3.795
.960	1.028	1.077	1.147	1.264	1.468	1.752	2.097	2.456

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL, 1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .645

AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX

10.850	10.263	9.709	9.191	8.913	8.489	7.916	7.189	6.929
9.811	9.453	9.128	8.719	8.568	8.292	7.795	6.959	6.616
8.746	8.339	8.243	7.962	7.859	7.763	7.454	6.556	6.171
7.584	7.207	7.085	6.956	6.981	6.967	6.695	5.843	5.546
6.266	5.858	5.867	5.910	5.950	5.880	5.560	5.046	4.997
4.846	4.440	4.548	4.775	4.783	4.655	4.547	4.588	4.867
3.413	3.260	3.178	3.305	3.475	3.598	3.747	4.072	4.489
2.018	2.066	1.978	2.007	2.163	2.474	2.846	3.157	3.551
.999	1.057	1.104	1.170	1.279	1.458	1.700	1.994	2.320

Table B.8.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL,1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .209

AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX

11.077	11.120	11.061	10.838	10.849	10.666	10.211	9.421	7.929
10.572	10.644	10.667	10.481	10.701	10.592	10.207	9.317	7.664
9.721	9.691	10.030	9.898	10.260	10.250	9.879	8.959	7.331
8.592	8.593	9.234	9.062	9.180	9.400	9.049	8.150	6.756
7.286	7.271	7.892	7.834	7.823	8.089	7.877	7.333	6.320
5.690	5.708	6.199	6.414	6.679	6.977	7.081	7.202	6.574
3.895	4.114	4.499	4.743	5.151	5.624	6.024	6.340	5.923
2.137	2.247	2.401	2.639	3.040	3.448	3.905	4.345	4.370
.925	.970	1.039	1.158	1.340	1.548	1.847	2.280	2.739

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL,1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .336

AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX

10.893	10.797	10.614	10.287	10.186	9.886	9.300	8.401	7.349
10.291	10.329	10.255	9.965	10.061	9.825	9.299	8.303	7.091
9.383	9.357	9.636	9.420	9.661	9.520	9.009	7.987	6.774
8.241	8.246	8.833	8.625	8.653	9.743	9.265	7.275	6.236
6.964	6.953	7.533	7.446	7.378	7.537	7.210	6.563	5.832
5.430	5.450	5.908	6.090	6.300	6.507	6.495	6.455	6.071
3.723	3.929	4.288	4.506	4.862	5.256	5.542	5.704	5.477
2.065	2.167	2.310	2.529	2.995	3.256	3.637	3.958	4.065
.933	.973	1.039	1.154	1.334	1.538	1.823	2.227	2.683

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEBEL,1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .645

AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX

11.026	10.469	9.909	9.321	9.015	8.569	7.919	7.189	6.938
10.040	9.985	9.636	9.081	8.944	8.540	7.928	7.103	6.587
9.876	8.880	9.033	9.512	8.631	8.308	7.703	6.942	6.382
7.626	7.658	8.152	7.885	7.755	7.662	7.095	6.249	5.269
6.368	6.383	6.902	6.777	6.623	6.639	6.227	5.668	5.491
4.942	4.974	5.386	5.528	5.661	5.751	5.640	5.598	5.733
3.401	3.589	3.910	4.094	4.379	4.671	4.855	4.993	5.187
1.939	2.030	2.162	2.354	2.675	2.983	3.292	3.566	3.895
.973	1.008	1.079	1.199	1.392	1.611	1.904	2.314	2.764

Table B.8.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEDEL,1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .209

AZIMUTH = 180.00 DEGREES TOTAL RADIANCE MATRIX

11.129	11.184	11.030	10.774	10.863	10.727	10.313	9.591	8.086
10.662	11.018	11.015	10.665	10.877	10.798	10.460	9.870	8.222
9.895	10.278	10.793	10.424	10.714	10.624	10.433	10.002	8.259
8.835	9.236	9.847	9.979	10.311	10.314	10.290	9.798	8.057
7.629	7.995	8.511	8.866	9.880	10.341	10.282	9.435	7.661
6.167	6.486	6.623	7.113	8.435	9.995	10.226	9.402	7.900
4.160	4.378	4.446	5.021	6.073	7.540	9.276	9.327	8.410
2.142	2.298	2.452	2.694	3.195	4.246	6.281	9.336	10.772
.910	.995	1.104	1.240	1.553	2.281	4.069	9.131	22.640

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEDEL,1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .336

AZIMUTH = 180.00 DEGREES TOTAL RADIANCE MATRIX

10.995	10.905	10.606	10.240	10.206	9.945	9.392	8.544	7.486
10.423	10.898	10.740	10.234	10.276	10.044	9.542	8.787	7.594
9.569	10.070	10.709	10.185	10.242	9.955	9.561	8.926	7.622
8.483	8.949	9.683	9.993	10.096	9.825	9.530	8.809	7.452
7.295	7.687	8.272	8.807	10.006	10.176	9.751	8.641	7.156
5.884	6.210	6.393	6.935	8.510	10.341	10.231	9.003	7.600
3.973	4.190	4.287	4.906	6.094	7.947	10.269	9.986	8.780
2.069	2.220	2.386	2.673	3.292	4.679	7.625	12.232	13.425
.917	.998	1.123	1.318	1.783	2.922	5.928	14.532	33.776

BRDF-ATMOSPHERE ANALYSIS FOR PASTURE (KRIEDEL,1977).

WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM

OPTICAL DEPTH = .645

AZIMUTH = 180.00 DEGREES TOTAL RADIANCE MATRIX

11.289	10.739	9.972	9.317	9.054	8.629	7.997	7.304	7.066
10.333	11.256	10.625	9.628	9.285	8.807	8.168	7.517	7.165
9.113	10.090	11.211	10.215	9.634	9.939	8.300	7.689	7.202
7.879	8.599	9.354	10.816	10.304	9.317	8.548	7.739	7.086
6.682	7.190	8.069	9.302	11.268	10.711	9.415	7.976	6.954
5.353	5.727	6.085	7.082	9.478	12.418	11.487	9.317	7.835
3.623	3.860	4.062	4.887	6.638	9.933	14.239	13.019	10.423
1.941	2.096	2.321	2.769	3.807	6.319	12.121	20.761	19.826
.954	1.047	1.232	1.609	2.520	4.830	11.071	27.857	55.413

TABLE B.9.1 BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .302

AZIMUTH = 0.00 DEGREES		TOTAL RADIANCE MATRIX						
3.320	2.690	2.338	2.210	2.168	2.263	2.492	3.110	4.542
2.591	2.206	1.996	1.879	1.926	2.033	2.380	3.261	5.289
2.139	1.853	1.670	1.605	1.700	1.913	2.418	3.596	6.547
1.778	1.567	1.439	1.356	1.542	1.920	2.648	4.429	8.688
1.512	1.332	1.231	1.217	1.538	2.113	3.239	5.929	13.199
1.291	1.128	1.143	1.221	1.645	2.538	4.255	8.879	22.372
1.097	.998	1.087	1.327	1.916	3.147	6.234	14.908	41.458
1.005	.972	1.162	1.605	2.546	4.875	10.686	28.083	88.772
1.044	1.166	1.567	2.351	3.954	7.727	18.286	53.282	185.321

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .499

AZIMUTH = 0.00 DEGREES		TOTAL RADIANCE MATRIX						
4.704	3.340	2.697	2.353	2.212	2.237	2.397	2.858	3.855
3.249	2.522	2.152	1.950	1.945	2.024	2.329	3.072	4.628
2.469	2.022	1.759	1.657	1.733	1.941	2.437	3.521	5.945
1.939	1.666	1.506	1.423	1.612	2.012	2.785	4.565	8.206
1.622	1.410	1.308	1.315	1.665	2.311	3.603	5.424	13.062
1.378	1.215	1.244	1.370	1.874	2.950	5.010	10.197	23.166
1.191	1.111	1.240	1.567	2.346	3.938	7.845	18.090	44.764
1.121	1.131	1.398	2.018	3.289	6.387	14.067	33.641	89.802
1.196	1.379	1.915	2.960	5.210	10.607	25.456	71.270	213.951

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .927

AZIMUTH = 0.00 DEGREES		TOTAL RADIANCE MATRIX						
8.276	4.926	3.413	2.670	2.314	2.202	2.250	2.532	3.305
4.859	3.256	2.494	2.099	1.982	1.928	2.222	2.792	4.078
3.236	2.391	1.943	1.751	1.779	1.957	2.405	3.324	5.415
2.361	1.874	1.631	1.530	1.704	2.108	2.879	4.523	7.726
1.856	1.559	1.438	1.463	1.834	2.540	3.940	6.551	12.755
1.549	1.368	1.404	1.589	2.185	3.451	5.770	11.061	23.382
1.365	1.299	1.477	1.919	2.939	4.925	9.537	20.439	46.505
1.325	1.390	1.764	2.624	4.317	8.294	17.708	41.576	104.497
1.462	1.727	2.457	3.863	6.972	14.334	33.542	86.899	233.517

Table B.9.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .302

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
3.469	2.856	2.543	2.287	2.270	2.316	2.495	3.095	4.427	
2.755	2.486	2.278	2.053	2.042	2.120	2.380	3.083	4.687	
2.249	2.086	1.939	1.780	1.804	1.886	2.204	3.033	4.914	
1.884	1.758	1.672	1.565	1.602	1.771	2.155	3.038	5.234	
1.592	1.517	1.468	1.420	1.469	1.687	2.110	3.085	5.693	
1.377	1.310	1.322	1.303	1.427	1.691	2.225	3.357	6.250	
1.190	1.161	1.186	1.265	1.470	1.818	2.451	3.694	6.970	
1.086	1.097	1.135	1.358	1.739	2.232	2.983	4.498	8.250	
1.054	1.108	1.277	1.625	2.101	2.706	3.765	5.392	8.130	

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .499

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
5.018	3.616	2.938	2.474	2.331	2.298	2.403	2.836	3.732	
3.524	2.955	2.514	2.169	2.082	2.108	2.309	2.859	4.010	
2.669	2.339	2.076	1.857	1.837	1.896	2.174	2.864	4.259	
2.107	1.901	1.759	1.626	1.651	1.810	2.174	2.945	4.612	
1.722	1.611	1.536	1.486	1.541	1.766	2.192	3.073	5.105	
1.470	1.391	1.395	1.390	1.531	1.818	2.383	3.466	5.698	
1.281	1.253	1.285	1.387	1.620	2.019	2.721	3.914	6.468	
1.194	1.217	1.277	1.531	1.941	2.520	3.342	4.827	7.740	
1.200	1.275	1.470	1.854	2.377	3.069	4.204	5.749	7.718	

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .927

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX						
9.047	5.491	3.875	2.895	2.474	2.282	2.262	2.506	3.130	
5.426	4.085	3.059	2.425	2.170	2.089	2.188	2.556	3.463	
3.668	2.920	2.381	2.014	1.897	1.898	2.097	2.605	3.722	
2.613	2.218	1.940	1.740	1.725	1.846	2.149	2.746	4.091	
2.006	1.807	1.666	1.599	1.644	1.853	2.236	2.940	4.601	
1.662	1.547	1.523	1.528	1.676	1.964	2.512	3.429	5.209	
1.455	1.419	1.449	1.574	1.828	2.261	2.975	3.967	6.004	
1.390	1.421	1.508	1.792	2.223	2.876	3.693	4.972	7.236	
1.46	1.560	1.785	2.209	2.804	3.542	4.678	5.962	7.237	

Table B.9.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM. ALTITUDE = 900.00 KM

OPTICAL DEPTH = .302

AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX

3.645	2.965	2.612	2.407	2.331	2.369	2.535	3.080	4.262
2.865	2.643	2.430	2.228	2.227	2.243	2.427	2.998	4.138
2.358	2.275	2.164	1.991	2.027	2.078	2.292	2.877	4.043
1.955	1.954	1.835	1.740	1.893	2.002	2.200	2.779	3.997
1.673	1.667	1.596	1.504	1.661	1.874	2.165	2.715	4.016
1.414	1.422	1.390	1.363	1.520	1.752	2.117	2.672	4.039
1.213	1.212	1.228	1.251	1.413	1.671	1.961	2.562	3.992
1.066	1.037	1.071	1.126	1.272	1.539	1.906	2.554	4.273
1.042	1.053	1.166	1.376	1.639	1.976	2.546	3.399	4.722

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM. ALTITUDE = 900.00 KM

OPTICAL DEPTH = .499

AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX

5.388	3.877	3.101	2.633	2.414	2.359	2.440	2.814	3.562
3.786	3.277	2.795	2.426	2.303	2.243	2.347	2.738	3.447
2.869	2.654	2.424	2.144	2.091	2.086	2.231	2.648	3.362
2.222	2.176	2.003	1.860	1.954	2.012	2.151	2.573	3.324
1.823	1.802	1.706	1.606	1.720	1.899	2.132	2.528	3.349
1.519	1.521	1.482	1.452	1.591	1.791	2.104	2.512	3.360
1.308	1.307	1.323	1.345	1.500	1.737	1.985	2.449	3.351
1.177	1.154	1.191	1.250	1.392	1.647	1.979	2.484	3.636
1.196	1.200	1.309	1.506	1.753	2.067	2.569	3.258	4.109

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).

WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM. ALTITUDE = 900.00 KM

OPTICAL DEPTH = .927

AZIMUTH = 90.00 DEGREES TOTAL RADIANCE MATRIX

9.946	6.148	4.271	3.152	2.605	2.363	2.300	2.480	3.011
6.087	4.824	3.651	2.867	2.477	2.257	2.224	2.419	2.904
4.101	3.545	3.019	2.475	2.328	2.107	2.130	2.350	2.828
2.837	2.683	2.370	2.112	2.077	2.031	2.065	2.296	2.797
2.156	2.099	1.937	1.808	1.828	1.936	2.065	2.272	2.827
1.737	1.726	1.666	1.618	1.714	1.846	2.063	2.284	2.866
1.494	1.492	1.501	1.511	1.641	1.828	1.992	2.271	2.855
1.382	1.367	1.404	1.461	1.583	1.798	2.054	2.361	3.140
1.446	1.465	1.563	1.736	1.951	2.218	2.612	3.096	3.607

Table B.9.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEDEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .302
 AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX

3.950	3.161	2.767	2.487	2.440	2.462	2.650	3.163	4.247
3.103	3.072	2.813	2.549	2.516	2.570	2.712	3.199	4.153
2.508	2.651	2.629	2.473	2.531	2.600	2.722	3.205	4.145
2.064	2.212	2.256	2.266	2.476	2.593	2.777	3.285	4.233
1.758	1.843	1.937	2.034	2.355	2.621	2.896	3.404	4.385
1.500	1.572	1.648	1.829	2.212	2.524	2.897	3.489	4.367
1.219	1.280	1.429	1.619	1.879	2.214	2.638	3.350	4.690
1.077	1.103	1.290	1.467	1.559	1.813	2.278	3.264	5.289
1.041	1.070	1.239	1.506	1.823	2.234	2.937	4.072	5.904

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEDEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .499
 AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX

5.968	4.274	3.343	2.759	2.342	2.456	2.542	2.875	3.533
4.223	4.070	3.449	2.874	2.665	2.586	2.612	2.899	3.415
3.106	3.303	3.203	2.819	2.726	2.654	2.649	2.910	3.383
2.373	2.567	2.622	2.594	2.675	2.672	2.722	2.987	3.446
1.930	2.061	2.196	2.282	2.529	2.708	2.848	3.118	3.580
1.611	1.712	1.824	2.014	2.363	2.609	2.871	3.229	3.757
1.320	1.396	1.563	1.763	2.018	2.325	2.675	3.152	3.903
1.137	1.223	1.413	1.595	1.719	1.986	2.409	3.176	4.542
1.181	1.214	1.386	1.655	1.993	2.418	3.087	4.079	5.376

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEDEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .927
 AZIMUTH = 120.00 DEGREES TOTAL RADIANCE MATRIX

11.264	7.088	4.734	3.382	2.777	2.472	2.391	2.525	2.974
7.066	6.571	4.994	3.623	3.004	2.654	2.483	2.544	2.848
4.566	4.894	4.582	3.612	3.171	2.802	2.570	2.570	2.807
3.093	3.401	3.472	3.338	3.126	2.880	2.682	2.657	2.863
2.315	2.554	2.783	2.836	2.924	2.931	2.834	2.821	3.001
1.850	2.019	2.210	2.424	2.709	2.830	2.904	2.986	3.194
1.520	1.636	1.847	2.071	2.321	2.579	2.808	3.026	3.386
1.396	1.457	1.664	1.864	2.048	2.335	2.690	3.190	4.090
1.438	1.490	1.681	1.967	2.356	2.815	3.445	4.268	5.137

Table B.9.1 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .302
 AZIMUTH = 180.00 DEGREES TOTAL RADIANCE MATRIX

4.448	3.477	2.926	2.610	2.550	2.594	2.727	3.180	4.207
3.419	4.721	3.851	3.259	3.008	2.990	3.076	3.436	4.283
2.660	3.681	5.278	4.330	3.747	3.521	3.547	3.839	4.597
2.244	2.946	4.143	6.095	5.089	4.402	4.229	4.420	5.201
1.905	2.437	3.301	4.829	7.497	6.349	5.501	5.431	6.212
1.610	2.014	2.649	3.709	5.976	9.960	8.583	7.569	8.071
1.348	1.607	2.043	2.817	4.347	7.943	14.890	13.336	12.744
1.147	1.289	1.647	2.297	3.392	5.966	12.974	28.769	29.304
1.045	1.138	1.444	2.044	3.099	5.395	11.325	33.363	99.146

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .499
 AZIMUTH = 180.00 DEGREES TOTAL RADIANCE MATRIX

6.966	4.984	3.589	2.922	2.671	2.587	2.611	2.881	3.490
4.836	7.361	5.345	3.965	3.322	3.076	2.993	3.104	3.490
3.348	5.202	8.190	6.012	4.532	3.840	3.564	3.526	3.731
2.589	3.688	5.868	9.512	7.098	5.330	4.548	4.242	4.294
2.093	2.815	4.156	6.924	11.795	8.931	6.658	5.661	5.399
1.726	2.227	3.101	4.798	8.743	15.874	12.229	9.067	7.753
1.441	1.752	2.324	3.434	5.877	12.076	24.103	19.123	14.329
1.251	1.420	1.856	2.713	4.369	8.531	20.356	45.866	39.086
1.180	1.300	1.670	2.451	4.000	7.670	18.221	52.807	138.432

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .606 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .927
 AZIMUTH = 180.00 DEGREES TOTAL RADIANCE MATRIX

13.532	8.509	5.204	3.645	2.951	2.610	2.455	2.522	2.914
8.497	14.223	9.181	5.677	4.055	3.304	2.893	2.734	2.894
5.038	9.130	15.708	10.231	6.422	4.601	3.709	3.222	3.111
3.405	5.526	10.299	18.207	12.103	7.520	5.341	4.205	3.718
2.522	3.723	6.278	12.233	22.467	15.149	9.300	6.424	5.071
1.981	2.725	4.192	7.438	15.583	29.955	20.479	12.319	8.333
1.636	2.077	2.977	4.903	9.531	21.803	44.418	30.732	18.064
1.454	1.698	2.329	3.677	6.626	14.331	36.188	78.297	54.846
1.434	1.627	2.153	3.338	5.926	12.339	30.459	85.375	192.334

TABLE 9.2 BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .209

AZINUTH =	0.00	DEGREES	TOTAL RADIANCE MATRIX						
2.954	2.742	2.739	2.732	2.786	2.816	2.842	2.885	3.061	
2.721	2.452	2.395	2.354	2.527	2.605	2.672	2.874	3.339	
2.491	2.138	2.100	2.052	2.211	2.386	2.625	3.012	4.038	
2.244	1.872	1.829	1.802	1.992	2.262	2.666	3.408	5.263	
1.987	1.659	1.616	1.615	1.874	2.191	2.831	4.174	8.111	
1.703	1.404	1.388	1.468	1.674	2.165	3.182	5.626	13.969	
1.348	1.135	1.178	1.290	1.559	2.303	4.016	8.818	27.088	
1.039	.868	1.035	1.314	1.747	3.008	6.336	16.621	56.886	
.640	.771	1.063	1.514	2.452	4.745	11.244	32.348	110.183	

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .336

AZINUTH =	0.00	DEGREES	TOTAL RADIANCE MATRIX						
3.130	2.802	2.718	2.661	2.677	2.675	2.672	2.687	2.875	
2.783	2.450	2.351	2.284	2.426	2.483	2.537	2.728	3.191	
2.489	2.112	2.051	1.992	2.134	2.298	2.535	2.946	3.956	
2.214	1.839	1.787	1.760	1.944	2.218	2.651	3.489	5.297	
1.949	1.629	1.588	1.596	1.863	2.217	2.958	4.501	8.386	
1.670	1.388	1.383	1.483	1.732	2.324	3.549	6.501	14.809	
1.334	1.143	1.208	1.365	1.737	2.674	4.882	10.865	29.246	
1.049	.912	1.115	1.480	2.095	3.784	8.199	21.185	62.069	
.688	.847	1.202	1.791	3.071	6.231	15.055	42.114	121.798	

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .645

AZINUTH =	0.00	DEGREES	TOTAL RADIANCE MATRIX						
3.849	3.097	2.759	2.568	2.497	2.442	2.411	2.437	2.702	
3.084	2.525	2.303	2.171	2.250	2.278	2.326	2.554	3.032	
2.567	2.098	1.974	1.888	1.998	2.146	2.389	2.838	3.821	
2.194	1.794	1.715	1.684	1.856	2.137	2.613	3.541	5.206	
1.894	1.580	1.537	1.560	1.839	2.252	3.127	4.821	8.391	
1.618	1.364	1.375	1.510	1.832	2.578	4.068	7.422	15.061	
1.317	1.164	1.265	1.501	2.046	3.279	6.127	13.071	30.097	
1.077	1.000	1.265	1.781	2.700	5.045	10.869	26.124	64.365	
.795	.999	1.465	2.287	4.128	8.599	20.440	52.741	129.000	

Table B.9.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .209

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
3.000	2.845	2.897	2.855	2.824	2.850	2.798	2.726	2.906
2.821	2.650	2.741	2.664	2.597	2.637	2.587	2.571	2.890
2.588	2.441	2.594	2.461	2.362	2.370	2.398	2.544	3.038
2.371	2.206	2.400	2.291	2.173	2.180	2.224	2.480	3.236
2.093	1.980	2.155	2.111	2.043	2.019	2.084	2.467	3.557
1.786	1.748	1.928	1.922	1.917	1.970	2.095	2.623	4.027
1.452	1.443	1.598	1.648	1.685	1.870	2.120	2.732	4.712
1.158	1.112	1.286	1.483	1.656	1.937	2.224	3.010	5.400
.659	.776	.955	1.178	1.484	1.891	2.559	3.459	4.985

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .336

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
3.196	2.922	2.887	2.788	2.719	2.710	2.631	2.543	2.724
2.901	2.674	2.700	2.588	2.498	2.512	2.448	2.427	2.733
2.601	2.421	2.531	2.383	2.273	2.269	2.289	2.431	2.900
2.344	2.167	2.331	2.215	2.099	2.104	2.155	2.420	3.126
2.054	1.937	2.091	2.046	1.984	1.972	2.059	2.460	3.475
1.751	1.711	1.879	1.876	1.881	1.951	2.116	2.689	3.965
1.432	1.425	1.575	1.634	1.689	1.901	2.209	2.874	4.689
1.158	1.123	1.297	1.504	1.697	2.025	2.381	3.243	5.382
.702	.822	1.008	1.249	1.585	2.031	2.755	3.689	4.991

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .645

AZIMUTH = 60.00 DEGREES			TOTAL RADIANCE MATRIX					
3.993	3.282	2.977	2.714	2.552	2.481	2.379	2.311	2.555
3.268	2.847	2.683	2.476	2.334	2.304	2.235	2.239	2.577
2.737	2.445	2.443	2.253	2.120	2.098	2.119	2.276	2.750
2.345	2.124	2.215	2.082	1.969	1.974	2.044	2.324	2.987
2.006	1.871	1.979	1.931	1.880	1.890	2.012	2.423	3.346
1.699	1.650	1.787	1.792	1.815	1.912	2.134	2.730	3.938
1.404	1.399	1.534	1.609	1.695	1.946	2.328	2.999	4.539
1.169	1.152	1.323	1.544	1.768	2.163	2.597	3.465	5.204
.801	.924	1.118	1.397	1.766	2.261	3.030	3.911	4.886

Table B.9.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .209
 AZIMUTH = 90.00 DEGREES

TOTAL RADIANCE MATRIX								
3.048	2.897	2.920	2.924	2.915	2.935	2.946	2.913	3.075
2.952	2.796	2.783	2.778	2.827	2.925	2.937	2.906	3.064
2.808	2.629	2.519	2.527	2.607	2.825	2.909	2.883	3.006
2.586	2.373	2.241	2.241	2.370	2.637	2.781	2.771	2.935
2.294	2.079	1.897	1.947	2.157	2.420	2.525	2.568	2.876
1.932	1.791	1.635	1.696	1.939	2.143	2.209	2.307	2.775
1.533	1.456	1.403	1.475	1.652	1.809	1.926	1.951	2.540
1.190	1.140	1.181	1.227	1.298	1.416	1.578	1.794	2.477
.655	.752	.877	1.000	1.176	1.429	1.848	2.259	2.655

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .336
 AZIMUTH = 90.00 DEGREES

TOTAL RADIANCE MATRIX								
3.268	2.999	2.931	2.865	2.809	2.791	2.764	2.701	2.871
3.052	2.849	2.772	2.717	2.724	2.780	2.756	2.696	2.861
2.830	2.630	2.494	2.467	2.511	2.685	2.731	2.677	2.809
2.558	2.346	2.204	2.186	2.287	2.512	2.616	2.582	2.745
2.250	2.042	1.862	1.901	2.083	2.313	2.390	2.408	2.693
1.891	1.757	1.607	1.660	1.881	2.060	2.112	2.198	2.602
1.509	1.436	1.386	1.452	1.617	1.761	1.775	1.889	2.390
1.187	1.141	1.131	1.225	1.294	1.409	1.565	1.762	2.336
.694	.783	.899	1.016	1.182	1.416	1.793	2.154	2.505

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .645
 AZIMUTH = 90.00 DEGREES

TOTAL RADIANCE MATRIX								
4.151	3.451	3.086	2.818	2.649	2.558	2.489	2.436	2.689
3.502	3.125	2.848	2.657	2.564	2.545	2.483	2.433	2.681
3.009	2.731	2.514	2.392	2.359	2.457	2.461	2.420	2.632
2.570	2.349	2.172	2.109	2.155	2.306	2.366	2.345	2.573
2.196	2.001	1.817	1.834	1.961	2.138	2.186	2.205	2.524
1.830	1.709	1.569	1.606	1.786	1.925	1.966	2.034	2.441
1.474	1.411	1.367	1.421	1.563	1.685	1.697	1.803	2.245
1.192	1.155	1.191	1.234	1.298	1.406	1.549	1.717	2.199
.799	.864	.964	1.068	1.215	1.417	1.732	2.038	2.364

Table B.9.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .209

AZIMUTH = 120.00 DEGREES		TOTAL RADIANCE MATRIX						
3.106	2.953	2.971	2.995	2.981	2.970	2.998	2.992	3.099
3.007	2.942	2.958	3.062	3.073	3.030	3.118	3.125	3.172
2.855	2.772	2.756	2.969	3.108	3.089	3.186	3.251	3.252
2.624	2.532	2.493	2.788	3.074	3.084	3.208	3.374	3.382
2.325	2.286	2.245	2.548	2.941	3.140	3.328	3.404	3.446
1.985	1.999	2.015	2.300	2.720	3.022	3.277	3.355	3.395
1.603	1.748	1.840	1.998	2.293	2.595	2.914	3.053	3.225
1.330	1.577	1.835	1.785	1.758	1.982	2.305	2.713	3.370
.683	.838	1.011	1.106	1.255	1.523	1.972	2.464	2.959

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .336

AZIMUTH = 120.00 DEGREES		TOTAL RADIANCE MATRIX						
3.356	3.087	2.999	2.944	2.878	2.826	2.810	2.764	2.984
3.139	3.058	3.001	3.020	2.976	2.889	2.920	2.874	2.939
2.895	2.830	2.795	2.935	3.019	2.952	2.987	2.984	3.004
2.606	2.532	2.495	2.756	2.986	2.952	3.012	3.091	3.118
2.285	2.260	2.230	2.507	2.852	3.004	3.124	3.123	3.177
1.943	1.964	1.986	2.254	2.636	2.890	3.080	3.088	3.134
1.575	1.713	1.805	1.954	2.225	2.492	2.756	2.835	2.903
1.315	1.544	1.786	1.741	1.722	1.929	2.214	2.551	3.147
.716	.854	1.014	1.108	1.258	1.516	1.931	2.383	2.881

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .645

AZIMUTH = 120.00 DEGREES		TOTAL RADIANCE MATRIX						
4.350	3.656	3.216	2.923	2.728	2.597	2.528	2.482	2.597
3.707	3.564	3.264	3.032	2.849	2.673	2.629	2.569	2.744
3.137	3.122	3.029	2.968	2.920	2.754	2.702	2.664	2.803
2.650	2.626	2.598	2.786	2.890	2.772	2.738	2.759	2.912
2.248	2.262	2.267	2.496	2.747	2.820	2.843	2.804	2.975
1.986	1.927	1.974	2.216	2.534	2.711	2.820	2.797	2.948
1.535	1.668	1.766	1.908	2.145	2.365	2.566	2.615	2.835
1.300	1.500	1.717	1.692	1.700	1.895	2.143	2.430	3.036
.801	.914	1.059	1.162	1.333	1.594	1.986	2.435	2.971

Table B.9.2 Continued

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 23.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .209

AZIMUTH = 180.00 DEGREES		TOTAL RADIANCE MATRIX						
3.158	3.043	3.182	3.199	3.099	3.131	3.122	3.028	3.122
3.070	3.364	3.719	3.786	3.475	3.529	3.484	3.268	3.309
2.927	3.375	4.269	4.385	3.936	3.966	3.928	3.683	3.601
2.729	3.276	4.180	4.658	4.427	4.550	4.549	4.228	3.994
2.451	3.018	3.862	4.396	4.881	5.271	5.424	4.983	4.597
2.254	2.795	3.446	4.042	4.665	5.769	6.171	5.901	5.542
1.809	2.256	2.820	3.351	3.919	5.186	6.911	7.354	7.332
1.450	1.878	2.445	2.802	3.241	4.556	7.348	10.598	11.787
.707	.901	1.139	1.375	1.777	2.673	4.879	10.029	23.283

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 10.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .336

AZIMUTH = 180.00 DEGREES		TOTAL RADIANCE MATRIX						
3.458	3.219	3.219	3.147	2.995	2.976	2.921	2.790	2.897
3.246	3.672	3.872	3.792	3.400	3.374	3.262	2.997	3.050
2.985	3.555	4.567	4.529	3.946	3.845	3.705	3.382	3.313
2.717	3.327	4.351	5.011	4.630	4.536	4.360	3.922	3.693
2.411	2.997	3.902	4.625	5.363	5.523	5.375	4.734	4.322
2.199	2.737	3.412	4.116	5.013	6.464	6.579	5.930	5.417
1.767	2.202	2.767	3.352	4.102	5.793	8.142	8.254	7.781
1.425	1.829	2.380	2.772	3.335	4.961	8.580	13.340	14.368
.734	.913	1.154	1.439	1.981	3.267	6.632	15.298	34.359

BRDF-ATMOSPHERE ANALYSIS FOR CONIFEROUS FOREST (KRIEBEL, 1977).
 WAVELENGTH = .866 MICROMETERS, VISIBILITY = 4.00 KM, ALTITUDE = 900.00 KM
 OPTICAL DEPTH = .645

AZIMUTH = 180.00 DEGREES		TOTAL RADIANCE MATRIX						
4.612	3.946	3.479	3.137	2.849	2.733	2.621	2.497	2.705
3.977	4.872	4.586	4.014	3.367	3.161	2.948	2.677	2.844
3.287	4.326	5.811	5.286	4.215	3.767	3.431	3.052	3.101
2.786	3.641	5.170	6.477	5.602	4.839	4.247	3.650	3.508
2.378	3.063	4.239	5.667	7.277	6.770	5.771	4.706	4.256
2.119	2.683	3.484	4.597	6.479	9.137	8.444	6.742	5.754
1.705	2.133	2.747	3.552	4.943	8.122	12.473	11.567	9.467
1.393	1.763	2.315	2.853	3.842	6.552	12.907	21.689	20.736
.809	.980	1.257	1.704	2.674	5.096	11.615	28.463	55.947

VISIBILITY = 5.0 km

λ	1		2		3	
	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T
.675	.03	1.766	.04	2.057	.05	2.193
.800	.39	8.867	.43	10.211	.48	10.632

VISIBILITY = 10.0 km

λ	1		2		3	
	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T
.675	.03	1.685	.04	2.045	.05	2.252
.800	.39	9.570	.43	11.118	.48	11.732

VISIBILITY = 23.0 km

λ	1		2		3	
	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T
.675	.03	1.638	.04	2.048	.05	2.303
.800	.39	10.100	.43	11.808	.48	12.597

- 1: $\theta_o = 15^\circ$, $\theta_s = 37^\circ$ AZ = 40°
 2: $\theta_o = 30^\circ$, $\theta_s = 31^\circ$ AZ = 53°
 3: $\theta_o = 45^\circ$, $\theta_s = 33^\circ$ AZ = 43°

Table B.10.1 Comparison of field measured bidirectional reflectance (ρ_λ) with predicted sensor radiance (L_T) from immature wheat for two wavelengths and three atmospheric visibilities. (Data derived from de Boer et al., 1974.)

$\lambda = .675 \text{ } \mu\text{m}$ $\tau = .695$

VISIBILITY (km)	θ_0 (degrees)									
	0		15		25		35		45	
	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T
5.0	.04	1.712	.06	2.000	.07	2.165	.09	2.517	.14	3.432
10.0	.04	1.634	.06	2.001	.07	2.201	.09	2.614	.14	3.659
23.0	.04	1.590	.06	2.013	.07	2.246	.09	2.699	.14	3.857

$\lambda = .800 \text{ } \mu\text{m}$ $\tau = .586$

VISIBILITY (km)	θ_0 (degrees)									
	0		15		25		35		45	
	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T	ρ_λ	L_T
5.0	.10	2.086	.11	2.191	.17	3.102	.19	3.369	.25	4.225
10.0	.10	2.128	.11	2.270	.17	3.292	.19	3.606	.25	4.580
23.0	.10	2.170	.11	2.335	.17	3.439	.19	3.789	.25	4.861

Table B.10.2 Comparison of field measured bidirectional reflectance (ρ_λ) and predicted sensor radiance (L_T) from a stand of mature wheat for two wavelengths and three atmospheric visibilities. Solar zenith angle was 53° , azimuth angle between sun and sensor was 70° . (Data derived from de Boer et al., 1974.)

APPENDIX C

3-Dimensional Plots of Example Bidirectional Reflectance Functions.

C.1.1 Spherical Grass Canopy with LAI = 1.2

C.1.2 Lodgepole Pine Canopy

Angular Dependence of Total Radiance from Five Natural Surfaces: Example Trends:

C.2.1 Total Radiance vs. Zenith View Angle, $\theta_s = 5^\circ$

C.2.2 Total Radiance vs. Zenith View Angle, $\theta_s = 55^\circ$

C.2.3 Total Radiance vs. Solar Zenith Angle, $\theta_o = 5^\circ$

C.2.4 Total Radiance vs. Solar Zenith Angle, $\theta_o = 55^\circ$

Angular Dependence of Target Radiance from Five Natural Surfaces: Example Trends:

C.3.1 Target Radiance vs. Zenith View Angle, $\theta_s = 5^\circ$

C.3.2 Target Radiance vs. Zenith View Angle, $\theta_s = 55^\circ$

C.3.3 Target Radiance vs. Solar Zenith Angle, $\theta_o = 5^\circ$

C.3.4 Target Radiance vs. Solar Zenith Angle, $\theta_o = 55^\circ$

LEGEND

Ø Spherical Grass Canopy, LAI = .5

+ Spherical Grass Canopy, LAI = 1.2

- Planophile Grass Canopy, LAI = .5

X Planophile Grass Canopy, LAI = 1.2

* Lodgepole Pine Canopy, LAI = 5.1

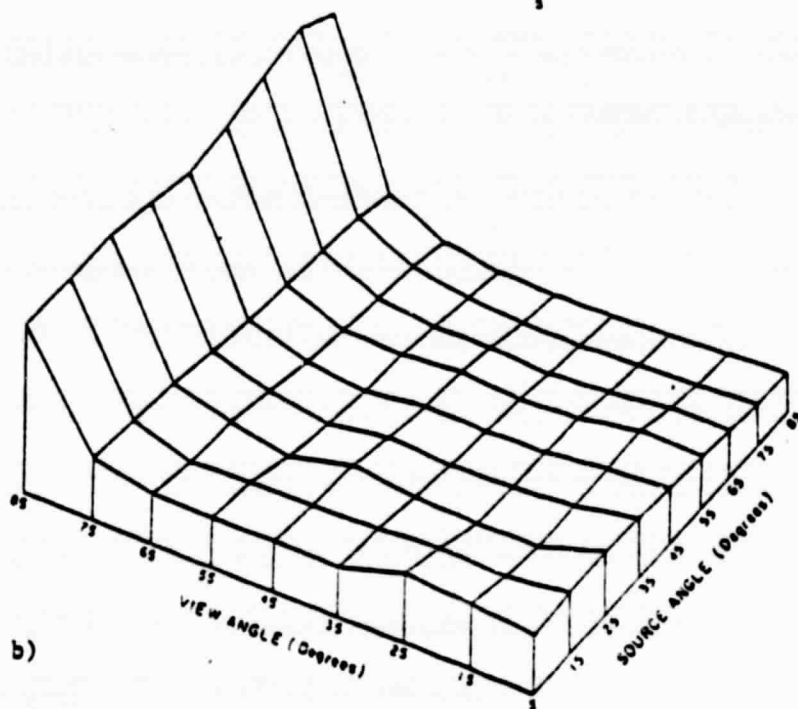
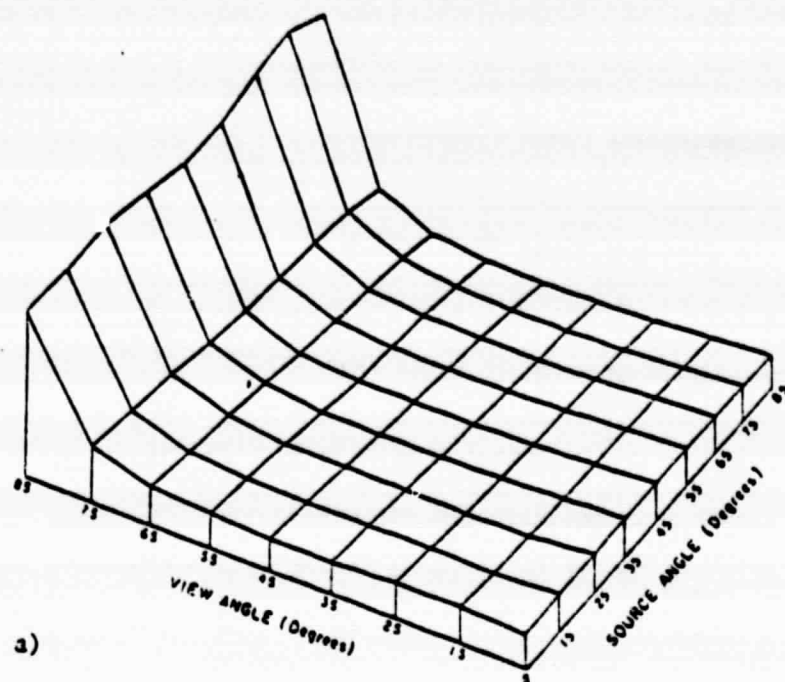
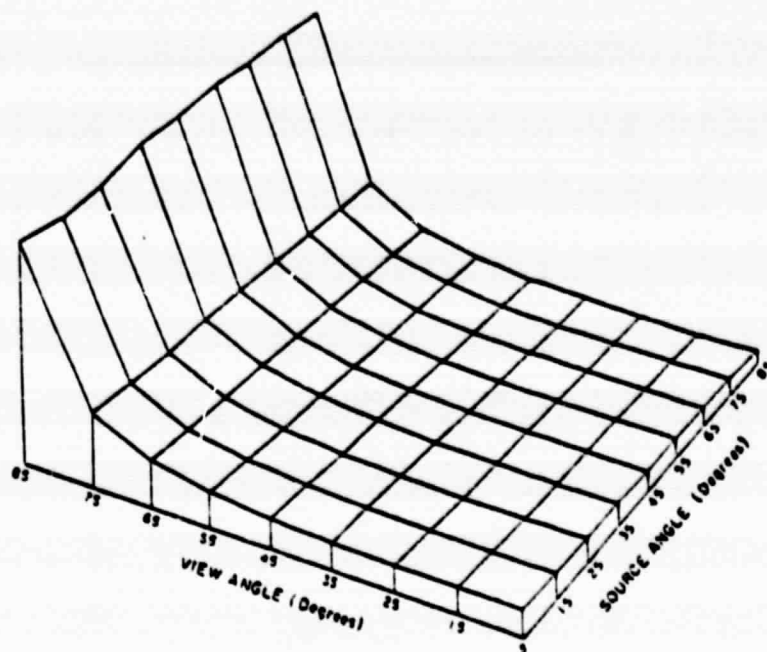
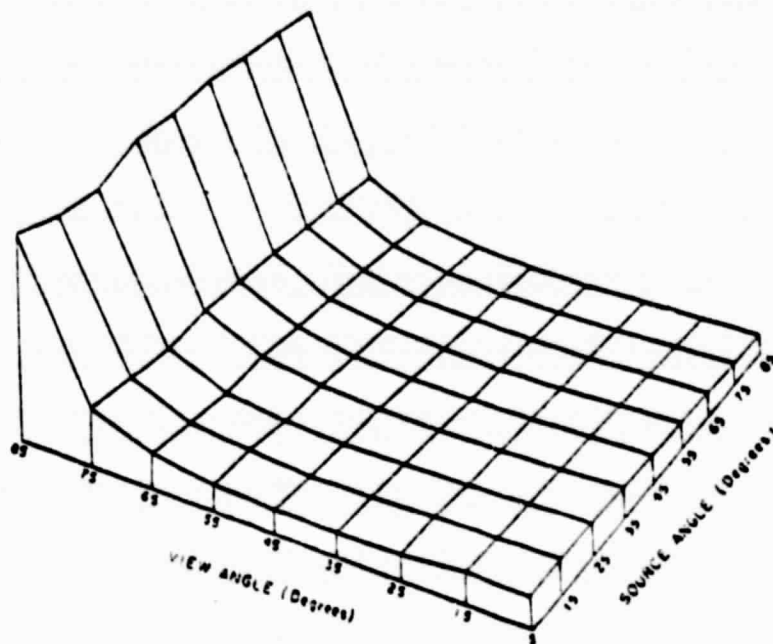


Figure C.1.1. Three-dimensional representation of the bidirectional reflectance factor matrix for a spherical grass canopy with an LAI of 1.2 at wavelengths of a) $0.68\mu\text{m}$ b) $0.80\mu\text{m}$. Relative response is shown on the vertical axis. Source and view angles are measured from zenith.



a)



b)

Figure c.1.2. Three-dimensional representation of the bidirectional reflectance factor matrix for lodgepole pine at wavelengths of a) $0.68\mu\text{m}$ b) $0.80\mu\text{m}$. Relative response is shown on the vertical axis. Source and view angles are measured from zenith.

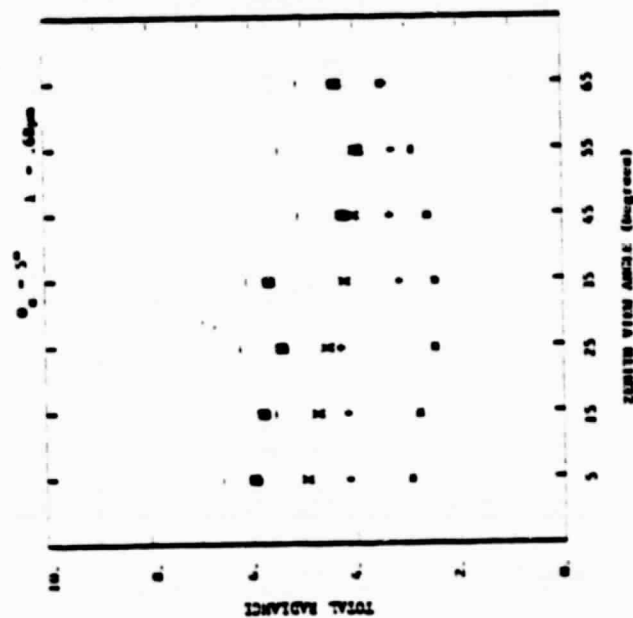
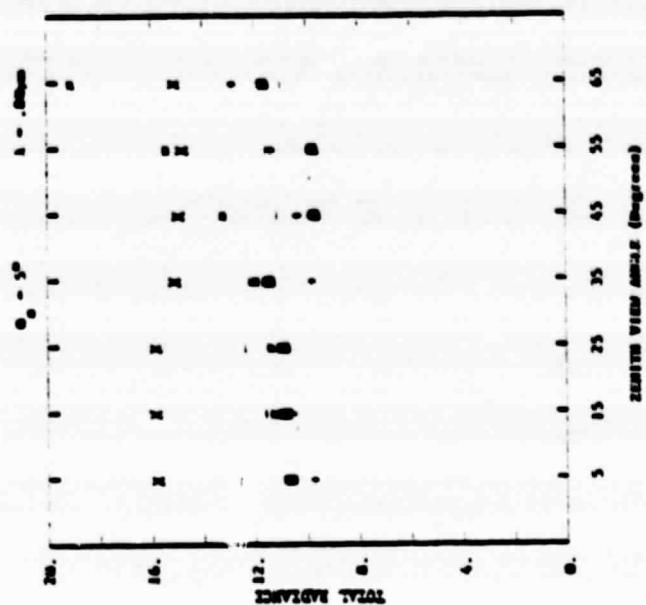


Figure C.2.1. Total radiance vs. zenith view angle for five natural surfaces at a solar zenith angle (θ_s) of 5° and two wavelengths.

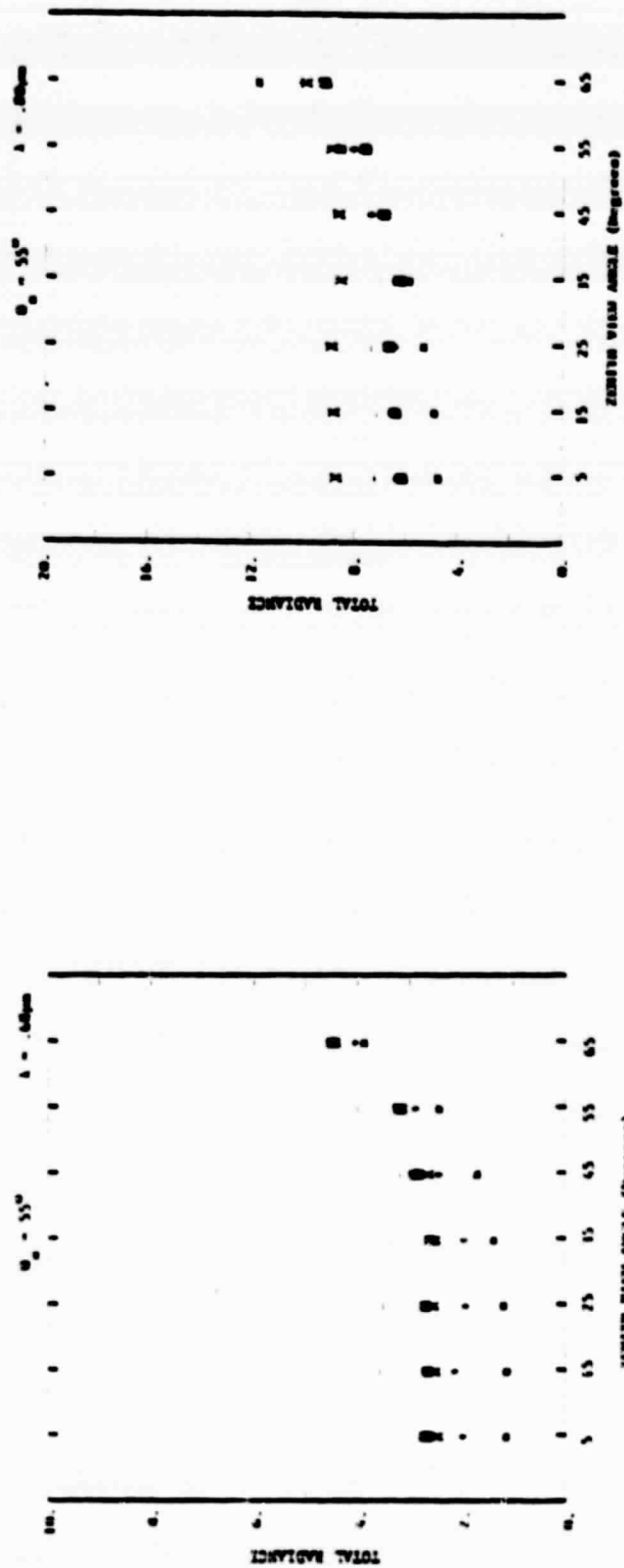


Figure C.2.2 Total radiance vs. zenith view angle for five natural surfaces at a solar zenith angle (θ_s) of 55° and two wavelengths.

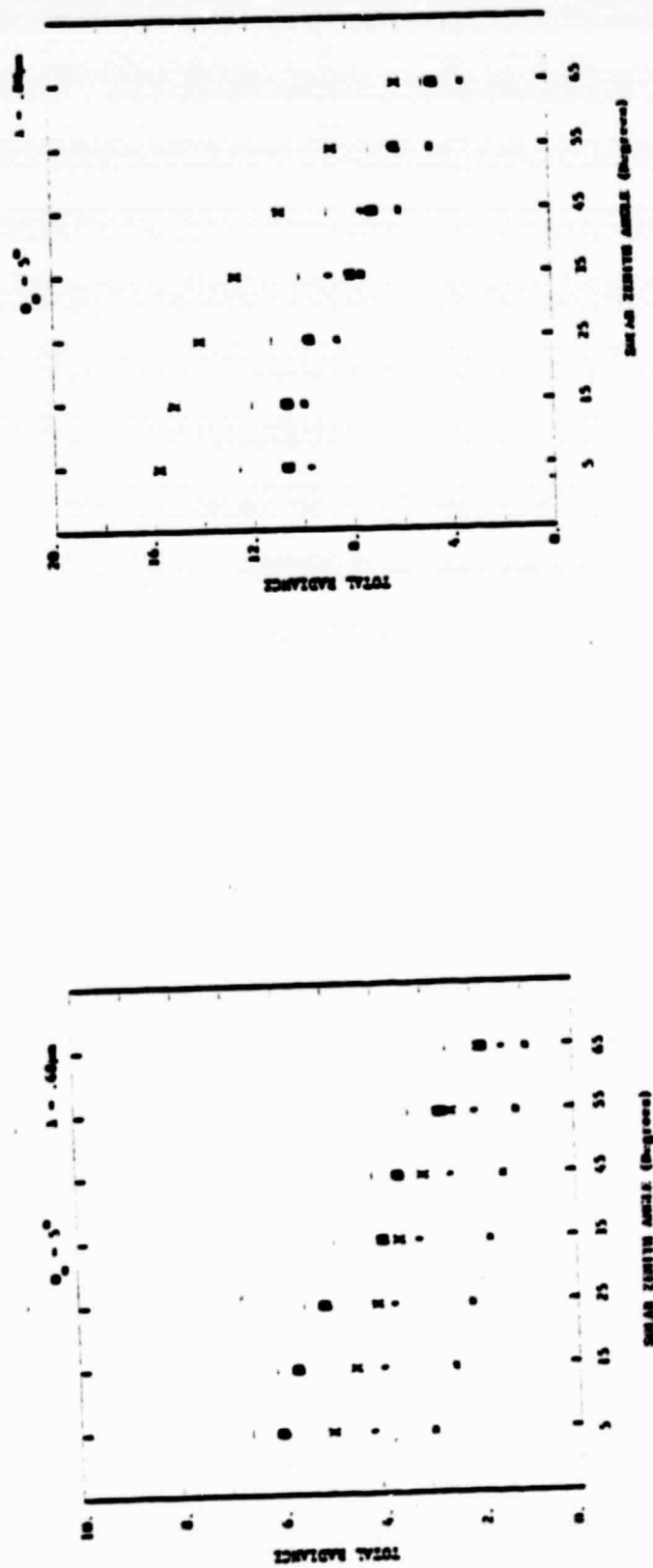


Figure C.2.3 Total radiance vs. solar zenith angle for five natural surfaces at a zenith view angle (θ_0) of 5° and two wavelengths.

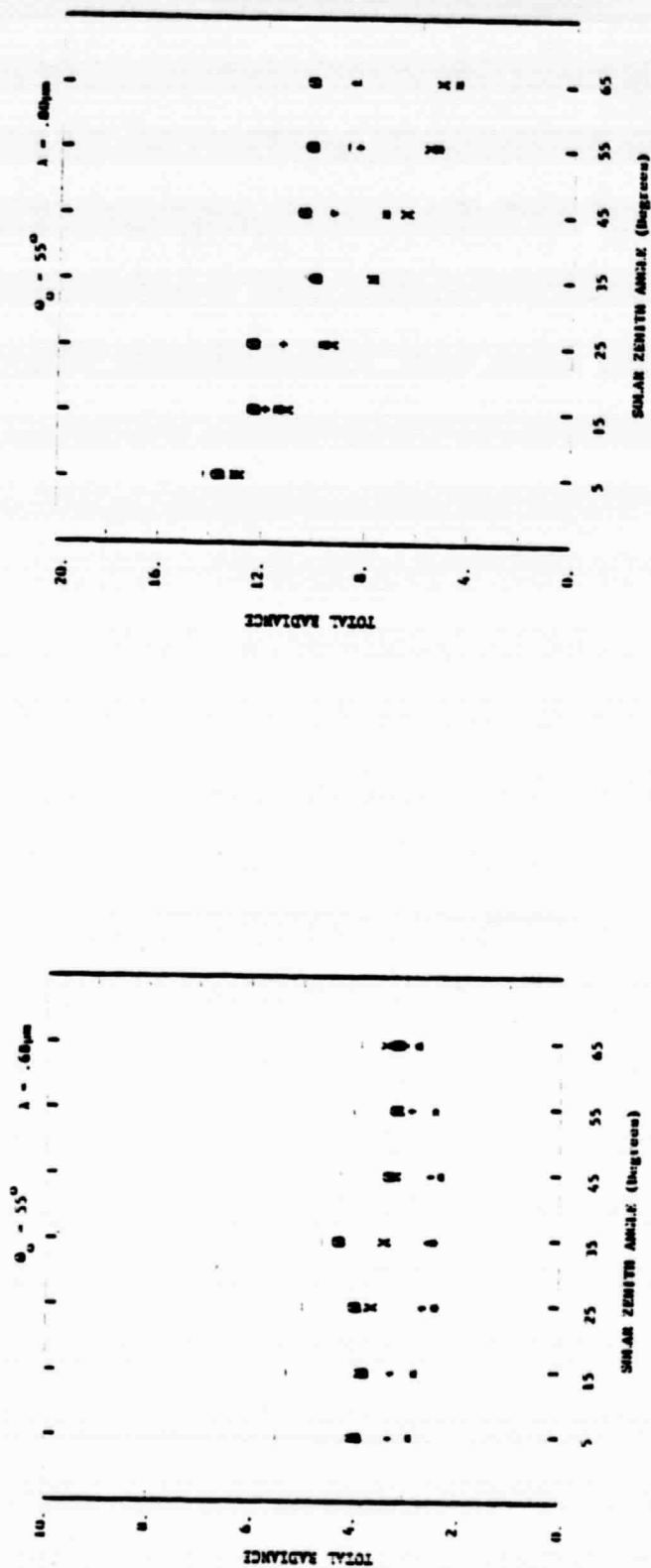


Figure C.2.4 Total radiance vs. solar zenith angle for five natural surfaces at a zenith view angle (θ_0) of 55° and two wavelengths.

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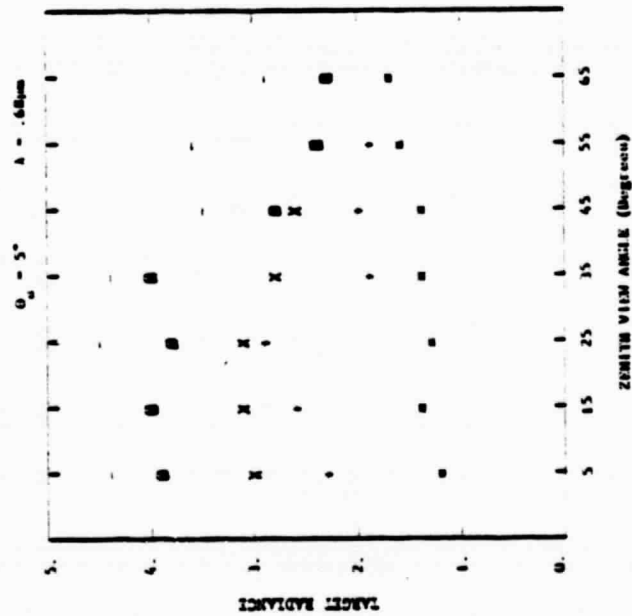
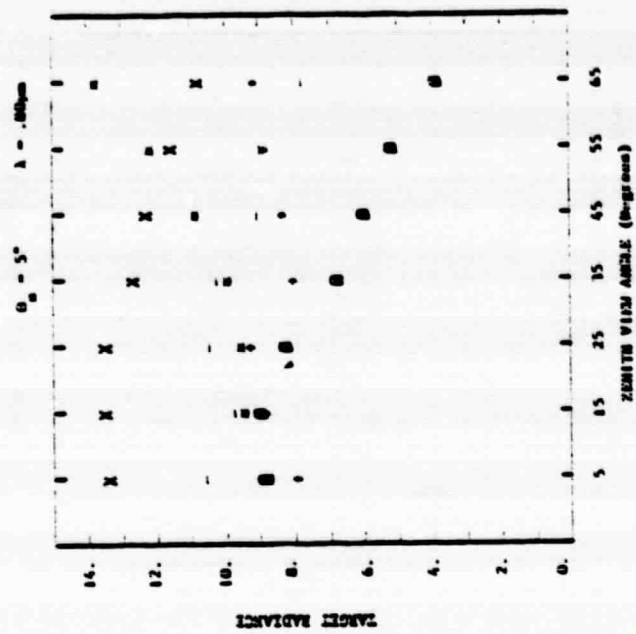


Figure C.3.1 Target radiance vs. zenith view angle for five natural surfaces at a solar zenith angle (θ_s) of 5° and two wavelengths.

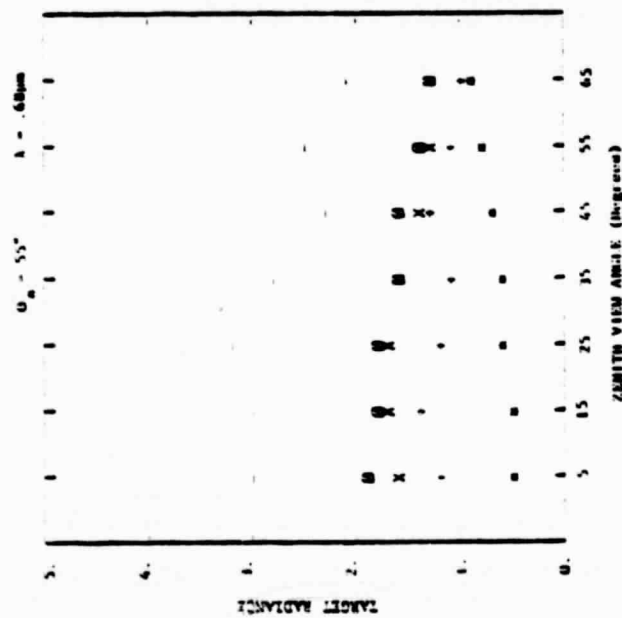
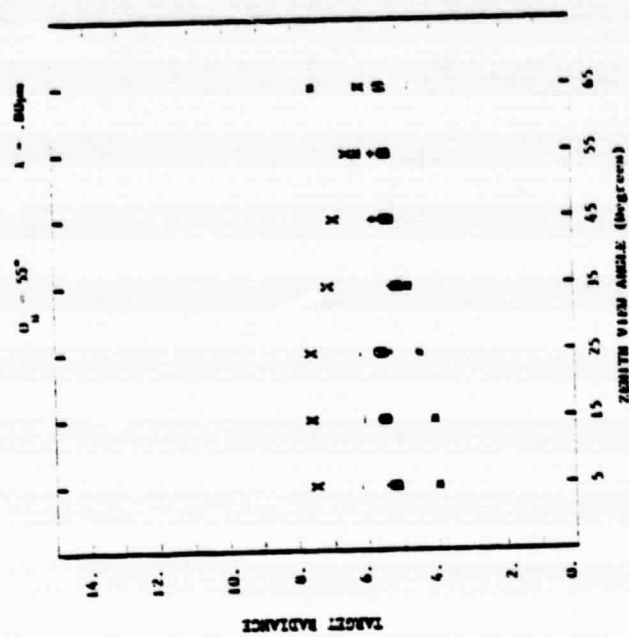


Figure C.3.2 Target radiance vs. zenith view angle for five natural surfaces at a solar zenith angle (θ_s) of 55° and two wavelengths.

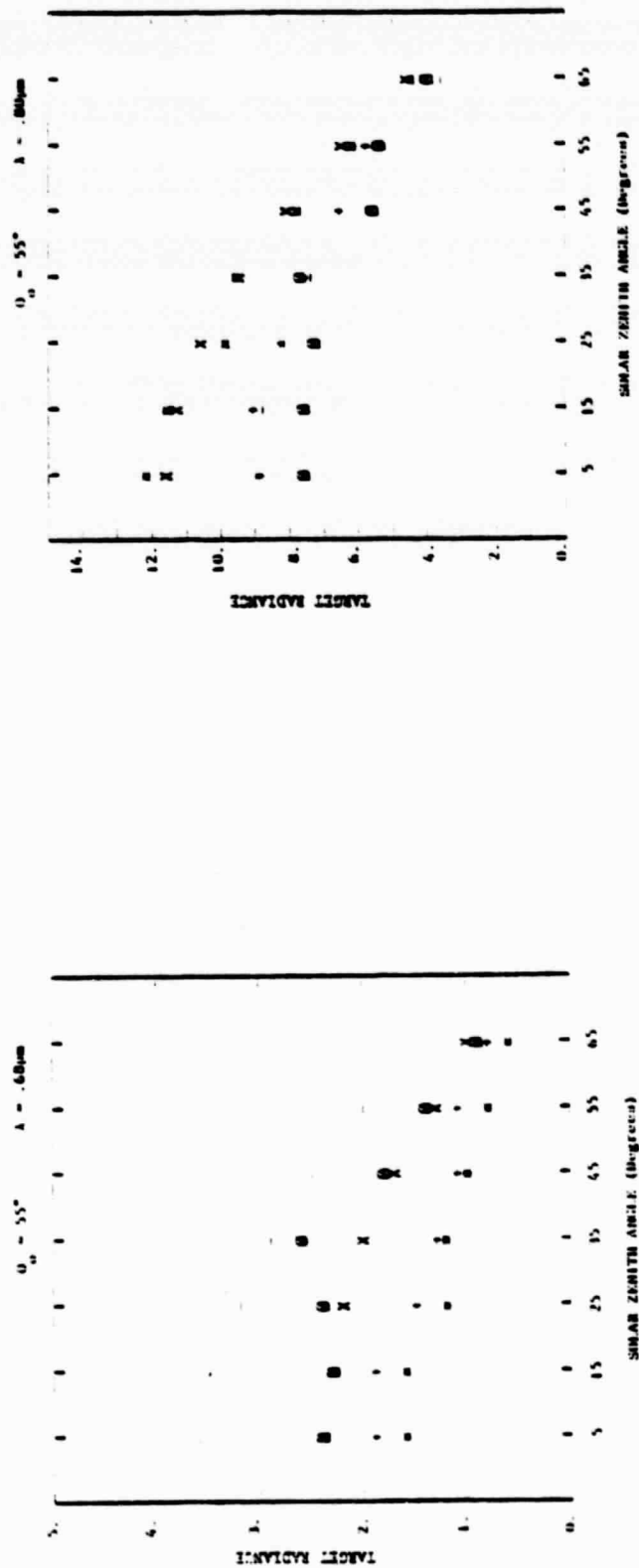


Figure 6.3.4 Target radiance vs solar zenith angle for five natural surfaces at a zenith view angle(θ_0) of 55° and two wavelengths.